

# **High-Flow Surface Water Investigation Work Plan - Mayflower Mill and Tailings Impoundments Area**

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## LIST OF ACRONYMS

ARSG	Animas River Stakeholder Group
CDPHE	Colorado Department of Public Health and Environment
cfs	cubic feet per second
DO	dissolved oxygen
DQO	Data Quality Objective
EPA	United States Environmental Protection Agency
HASP	Health and Safety Plan
ORP	oxidation-reduction potential
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
TA	Target Analyte
TDS	total dissolved solids
TSS	total suspended solids

## 1.0 INTRODUCTION

This High-Flow Surface Water Investigation Work Plan (High-Flow Work Plan) was prepared on behalf of Sunnyside Gold Corporation (Sunnyside) to investigate degraded water quality in the Animas River in the area adjacent to the Mayflower Mill and Tailings Impoundments Area near Silverton, Colorado (Figure 1-1). The High-Flow Work Plan describes the sampling and analysis plan (SAP) for the high-flow sampling event planned for the spring of 2015, during the rising limb of the hydrograph. A subsequent hydrogeologic investigation work plan will be prepared in a separate document for the low-flow sampling event that is planned for the summer/fall of 2015, when reduced flows are anticipated, in addition to other planned investigation activities such as drilling, well installation activities, and a geophysical survey.

There are four Mayflower Tailings Impoundments located approximately one mile to the northeast and upstream of Silverton on the right bank of the Animas River. As shown on Figure 1-2, the study area on the Animas River extends from just above the confluence of Arrastra Creek with the Animas River downstream to the 14<sup>th</sup> Street bridge in Silverton. Tailings Impoundment No. 1 is the most upstream, and subsequent impoundments are numbered in the downstream direction. Tailings impoundments No. 1 and 2 were reclaimed between 1991 and 1992. Tailings impoundment No. 3 was reclaimed in 1992 and Tailings Impoundment No. 4 was reclaimed between 2004 and 2006; although, the majority of the top cover was completed in 2004. In general, reclamation was accomplished by re-grading the side slopes to achieve a stable configuration and by covering the slopes and top surfaces with locally derived growth medium.

Extensive historic mining and milling activities have occurred throughout the upper Animas River basin over the past 150 years, including areas upstream of the Mayflower Tailings Impoundments. Discharging mine adits and historic mine waste rock piles are present at numerous locations, and historic mills typically discharged tailings to the Animas and its tributaries. Concentrations of metals such as cadmium, manganese, and zinc (among others) in the Animas River in the study area exceed State of Colorado water quality criteria. As shown by the water quality data presented in Section 3.0, increases in metals concentrations in the Animas River have been documented to occur in the vicinity of the Mayflower Mill and Tailings Impoundments Area.

Aside from this introductory section, the structure of this High-Flow Work Plan is as follows. Section 2.0 provides a statement regarding the work plan objective. Summary discussions of relevant previous studies are provided in Section 3.0. Section 4.0 identifies the data needs, intended data uses, and data quality objectives (DQOs) for the surface water investigation. The SAP for the high-flow surface water monitoring effort is presented in Section 5.0 along with a list of target analytes (TAs) and sampling methodologies. Reporting of the results for the high-flow

sampling program is described in Section 6.0. References cited in this High-Flow Work Plan are listed in Section 7.0. Appendices to this High-Flow Work Plan are listed below:

- Appendix A: Animas River Stakeholder Group (ARSG) Surface Water Sample Results
- Appendix B: Quality Assurance Project Plan (QAPP)
- Appendix C: Standard Operating Procedures (SOP)
- Appendix D: Health and Safety Plan (HASP)

## 2.0 INVESTIGATION OBJECTIVE

Elevated metals concentrations in the upper Animas River have been documented by personnel of the U.S. Geological Survey (USGS) (Kimball et al. [2010]) and others in the vicinity of the Mayflower Mill and Tailings Impoundments Area, as described in Section 3.0. However, the extent to which the mill and tailings impoundments serve as a source of metals to the river, and the pathways by which metals from the impoundments may enter the river, are unknown. This information is needed to identify approaches for reducing metals concentrations in the upper Animas River. Therefore, the primary objective of this investigation is to evaluate the temporal and spatial variations in the water quality of the upper Animas River within the study area to characterize changes in water chemistry through time during a range of flow conditions. This objective will be accomplished, in part, through the comparison of the current conditions to those observed by other surface water investigations conducted in the study area.

A study of the upper Animas River by Kimball et al. (2010) for data collected in August 2002 and April 2003 characterized water quality during historic low-flow conditions and relatively high-flow/spring melt conditions, respectively. The results from the Kimball et al. (2010) study indicated that water quality changes in response to flow conditions. The low-flow conditions observed in August 2002 allowed for the identification of potential point sources of inflow into the Animas River (e.g., seeps, springs, etc). Therefore, the low-flow sample locations for the Kimball et al. (2010) study are being used as a template for designing the SAP to evaluate current water quality conditions in 2015. It should be noted that during the August 2002 sampling event flows were at historic lows and flow conditions during the summer of 2015 may not resemble those observed in the summer of 2002.

As described in Section 5.0, an adaptive management approach will be employed. As such, the study will have an iterative approach that allows for modification to the SAP as warranted by observed site conditions.

### 3.0 SITE SETTING AND CONCEPTUAL SITE MODEL

This section will be further developed based on a desktop study wherein all relevant and available literature will be reviewed and summarized for the purpose of developing a preliminary site conceptual model. The literature review will be implemented concurrently with the preparation of a more extensive hydrogeologic investigation work plan.

For the purpose of work planning for the high-flow sampling event, this section focuses on summarizing published historical water quality and discharge data.

#### 3.1 2002 and 2003 Study of the Upper Animas River

The following is a brief summary of the findings from the surface water investigation conducted by the USGS in April 2002 and August 2003 (Kimball et. al., 2010). This investigation was conducted along a reach of the upper Animas River that is inclusive of the study area (Figure 1-2) for the proposed surface water investigation described in Section 5.0 of this High-Flow Work Plan. A mass-loading approach was developed by the USGS that focuses on metal loading to a stream through the development of detailed spatial profiles of stream discharge and chemistry. In general, this approach combines two established techniques, which include the tracer-dilution method for measuring stream discharge and synoptic water-quality sampling, for quantifying mass loading (mass per time). Quantification of mass loading rates can provide useful information regarding potential sources and can help support decisions regarding remedial action.

The investigation was comprised of two synoptic surface water sampling events. The first sampling event was conducted during relatively “low-flow” conditions in August 2002 and the second sampling event was conducted during relatively “high-flow” conditions in April 2003. The low-flow conditions monitored in August 2002 were near historic lows, and thus areas of seepage that would typically be submerged were visible and were thus sampled. During the low-flow sampling event, a total of 46 locations were sampled including 28 in-stream samples from the upper Animas River, 12 right bank samples from seeps and inflows into the river, and six left bank samples from seeps and inflows. It should be noted that the high-flow event was actually conducted prior to peak flows and occurred during the rising limb of the hydrograph. As described below in Section 3.3, peak flows in the upper Animas River typically occur between May and July. During the high-flow sampling event, six in-stream samples were collected from the upper Animas River. The sample locations for the high-flow event were based on a subset of the low-flow sample locations. During the high-flow event, seeps were generally submerged and were therefore not re-sampled. The sample locations for the low-flow and high-flow sampling events are shown on Figure 3-1.

The low-flow and high-flow sample results are summarized in Tables 3-1 and 3-2, respectively, and were compared to the lowest of the applicable Colorado Department of Public Health and Environment (CDPHE; herein referred to as Colorado) water quality standards. The Colorado water quality standards are stated as dissolved phase concentrations and are specific to the reach of the Animas River where the samples were collected (CDPHE, 2013 and CDPHE, 2014). If a result exceeded the Colorado water quality standard, its concentration is shown as bold and is highlighted in the table. Only the dissolved phase (i.e., field filtered by a 0.45 micron filter) sample results from the low-flow and high-flow sampling events are summarized in these tables. During the high-flow event, time-series samples were collected using automated sample collection techniques. The results shown in Table 3-2 generally represent the maximum concentrations through time at each sample location. Selection of the maximum concentration time interval at each sample location was based on the observed maximum concentration of zinc.

It should be noted that between 2003 and 2004, tailings in the power plant area were removed from along the Animas River and placed in Tailings Impoundment No.4. This work was completed after the 2002 and 2003 study by Kimball et al. (2010). Completion of reclamation work on Tailings Impoundment No. 4 also occurred after the 2002 and 2003 Kimball et al. (2010) study.

### 3.2 Animas River Stakeholder Group Sample Results

There are 11 ARSG surface water sample locations (A56, A58, and A60 to A68) in the study area. The results for the chemicals of interest are summarized in Table A-1 in Appendix A. This table summarizes the results from sampling events conducted between September 1991 and December 2011. The source of the data is the ARSG website.<sup>1</sup> The results were compared to the lowest of the applicable Colorado water quality standards. As previously discussed, the Colorado water quality standards are stated as dissolved phase concentrations and are specific to the reach of the Animas River where the samples were collected (CDPHE, 2013 and CDPHE, 2014). If a result exceeded the Colorado water quality standard, its concentration is shown as bold and is highlighted in the table.

### 3.3 Upper Animas River USGS Gauging Station Data

A USGS stream gauging station (09358000) is located in the upper Animas River at the furthest downstream point of the study area at the 14<sup>th</sup> Street bridge in Silverton (Figure 1-2). The mean monthly discharge from 1991 to 2014, as reported by the USGS, is summarized in Table 3-3. A hydrograph of the mean monthly discharge is shown on Figure 3-2 with the range of minimum and maximum mean monthly flows illustrated for each month as reported for the period of record from 1991 to 2014. The historical mean monthly discharge ranged from 13.4 cubic feet

<sup>1</sup> <http://www.animasriverstakeholdersgroup.org/page11.html>

per second (cfs) in January 2013 to 794 cfs in June 1997 (Table 3-3). In general, high-flow conditions (e.g., greater than 100 cfs) occur between May and July and low-flow conditions are present during the remainder of the year with the lowest flows typically occurring in January, February, and March. The standard deviation and minimum and maximum mean discharge values were calculated for each month for the period of record and are summarized in Table 3-3.

## 4.0 DATA QUALITY OBJECTIVES AND DATA NEEDS

This section identifies the data needs, intended data uses, and DQOs for the surface water investigation of the upper Animas River. As such, this section relies on information presented in Section 3.0, where background data characterizing the water quality and hydrology of the upper Animas River in the vicinity of the Mayflower Tailings Impoundments are provided.

The study area for the surface water investigation is shown on Figure 1-2. The chemicals of interest for the surface water investigation are those that were evaluated during the previous USGS study and include: calcium, magnesium, sodium, potassium, alkalinity, sulfate, chloride, bromide, silica, aluminum, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, molybdenum, nickel, silver, strontium, vanadium, and zinc. Additional TAs are further described in Section 5.1 of this Work Plan.

The principal questions that will be addressed by the surface water investigation are:

- **What is the water quality of the reach of the upper Animas River in the study area during a range of flow conditions?**
- **How does water quality vary under a range of distinct flow conditions and how does it vary spatially?**
- **Are the concentrations of the chemicals of interest within the reach of the upper Animas River in the study area influenced by the water quality of the inflows, including but not limited to seeps, springs, groundwater underflow, and tributary water bodies?**

## 4.1 Data Quality Objectives Analysis and Investigation Design

This section is organized to be generally consistent with EPA's guidance for application of their DQO process (EPA, 2006), which includes the seven steps listed below and described in detail in Section 4.2.

1. State the Problem
2. Identify the Goals of the Study
3. Identify Information Inputs
4. Define the Boundaries of the Study
5. Develop the Analytic Approach
6. Specify Performance and Acceptance Criteria
7. Develop the Plan for Collecting Data

Application of the DQO process results in identification of the specific types and quality of data needed to support the goals of the surface water investigation.

The DQO developed to address the aforementioned surface water investigation questions is summarized below. This DQO is written to generically address surface water investigation requirements (i.e., both low-flow and high-flow conditions) and will be included in the forthcoming hydrogeologic investigation work plan, along with additional DQOs for subsequent phases of investigation (e.g., geophysical investigation, tailings impoundment investigation, and groundwater investigation).

## 4.2 DQO 1: Surface Water Investigation

### DQO Step 1 - State the Problem

Previous investigations in the study area have identified elevated levels of metals in the upper Animas River, some of which are above Colorado water quality standards. The current sources of metal loads and their effects on river water quality remain uncertain. Therefore, collection of additional surface water data is needed to identify those sources, where possible. Specifically, additional data are needed to better understand the relationship, if any, between the Mayflower Mill and Tailings Impoundments Area and metals concentrations in the surface water of the upper Animas River adjacent to and downstream from this area.

### DQO Step 2 - Identify the Goals of the Study

The key questions to be answered by the surface water investigation are as follows:

- How do the concentrations of the chemicals of interest change in response to different flow conditions (e.g., high flow vs. low flow)?
- How do the concentrations of the chemicals of interest change with location along the reach of interest in the study area?
- How do the concentrations of the chemicals of interest change in relation to known inflows along the reach of interest in the study area?
- Which chemicals of interest currently exceed the applicable Colorado water quality standards (CDPHE, 2014) and where?

### DQO Step 3 - Identify Information Inputs

Previous investigations in the study area provided a characterization of the surface water flow conditions and surface water quality in the study area in 2002 and 2003, as discussed in Section 3.1. However, since then there have been remedial actions along the Animas River and these data may no longer be representative of current conditions. As such, the following types of information are needed to address the study goals listed in DQO Step 2.

- Concentrations of the chemicals of interest (described in Section 5.1) at multiple locations on the upper Animas River reach of interest, including locations of inflowing water along that reach, during both relatively high-flow and low-flow conditions.
- Colorado water quality standards for the Animas River in the study area (CDPHE, 2014).
- The available flow and water chemistry data collected by the USGS in 2002 and 2003 and by the ARSG between 1991 and 2011.
- 2002 through 2015 discharge records from the USGS Animas River gauging station 0935800.

### DQO Step 4 – Define the Boundaries of the Study

The spatial boundaries for the study area extend from just upstream of the confluence of the upper Animas River and Arrastra Creek downstream to the 14<sup>th</sup> Street bridge crossing (Figure 1-2).

The temporal boundaries for the study begin in 2002 with the low-flow sampling event conducted by the USGS and end with the final low-flow sampling event proposed for the summer/fall of 2015.

### DQO Step 5 – Develop the Analytic Approach

The following approach will be used to collect the specific types of new data needed to address the goals of the surface water investigation. Two or more synoptic sampling events will be conducted within the study boundaries along the upper Animas River. A work plan describing the low-flow sampling plan, along with other aspects of the Mayflower Tailings investigation, will be submitted at a later date. The events will be conducted at relatively high-flow and low-flow conditions. Additionally, where feasible, the inflows in the study area, which were identified by the USGS during their 2002 study, including tributary creeks, streams, and seeps will be sampled. However, during the high-flow event it is anticipated that many or all of the documented seeps will be submerged. If a proposed inflow sample location is submerged then a sample will be collected from the Animas River immediately downstream of the inflow location.

The data analyses that will be performed as part of the surface water investigation are as follows:

1. Compare the high-flow sampling results to the low-flow sampling results. Evaluate and describe the observed differences in concentrations for the two distinct flow conditions.
2. Compare the historical sampling results published by others to the results of this investigation.
3. Compare investigation results to applicable Colorado water quality standards. Identify the chemicals of interest that exceed their respective standard and the location(s) where the standard is exceeded.

Potential measurement errors (field and laboratory) and related uncertainties, for the data collected and the results of the data-analyses described above, will be evaluated and described.

#### DQO Step 6 – Specify Performance or Acceptance Criteria

Performance and acceptance criteria are defined and controlled through implementation of sampling and analytical methodologies designed to ensure that the data generated are of adequate quality for project decision-making purposes. If the quality assurance activities for sample collection and analysis specified in project documents are met, and the analytical precision and accuracy requirements specified in the QAPP (Appendix B) are met, the resulting data will be usable for characterizing the conditions in the study area and addressing the study goals stated herein.

The laboratory analysis methods selected for surface water samples need to provide quantitative data at concentrations low enough for meaningful comparison to applicable water quality standards. The proposed analytical methods for surface water and the target method detection limits and reporting limits typically achieved using the analysis method are specified in the QAPP (Appendix B).

#### DQO Step 7 – Develop the Plan for Obtaining Data

The detailed plans for obtaining the upper Animas surface water data in the study area are presented in SAP, which comprises Section 5.0 of this High-Flow Work Plan. The plans developed for surface water data collection are considered resource effective approaches that provide the quantities and quality of data needed to answer the surface water investigation questions consistent with the analytical approach (Step 5) and performance criteria (Step 6) described above.

## 5.0 SAMPLING AND ANALYSIS PLAN

This section presents the SAP for the proposed surface water investigation that has been developed to characterize the upper Animas River in the study area (e.g., adjacent to, upstream, and downstream of the Mayflower Tailings Impoundments) at or near high-flow conditions (herein referred to as the high-flow surface water sampling event). As previously discussed, additional potential subsequent phases of investigation (e.g., low-flow surface water investigation, geophysical investigation, tailings impoundment investigation, and groundwater investigation) will be described in a forthcoming hydrogeologic investigation work plan.

An adaptive management approach will be employed for this study and for future studies. As such, the investigation(s) will have an iterative approach that allows for modification to the SAP as warranted by site conditions.

The QAPP is provided in Appendix B. Standard operating procedures (SOPs) that describe surface water sampling procedures and methodologies are provided in Appendix C.

### 5.1 Target Analytes

The TAs for this investigation are summarized in Table 5-1 and include both laboratory parameters and field parameters. Laboratory parameters include: calcium, magnesium, sodium, potassium, alkalinity, sulfate, chloride, bromide, silica, silver, aluminum, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, molybdenum, nickel, strontium, vanadium, zinc, fluoride, hardness, total suspended solids (TSS) and total dissolved solids (TDS). As noted in Table 5-1, samples submitted for metals analyses will be reported as both dissolved phase and total recoverable metals. As described in the QAPP (Appendix B), the samples submitted for dissolved phase analysis will be field filtered with a 0.45 micron filter. Field parameters will be measured with a water quality instrument(s) and include: temperature, turbidity, pH, specific conductance, dissolved oxygen (DO), and oxidation reduction potential (ORP). The TAs for this study are based, in part, on the USGS study described in Section 3.1 (Kimball, et al., 2010) where chemicals of interest were first developed for the study area. The laboratory analytical methods, laboratory quality control procedures, and laboratory instrument calibration and maintenance are described in QAPP (Appendix B).

The applicable Colorado water quality standards for the TAs are summarized in Tables 5-1 and 5-2 (CDPHE, 2013 and CDPHE, 2014).

## 5.2 High-Flow Surface Water Investigation

As described in Section 1.0, the study area extends from just above the confluence of the upper Animas River and Arrastra Creek downstream to the 14<sup>th</sup> Street bridge crossing in Silverton (Figure 2-1). One high-flow synoptic surface water sampling event will be conducted in the study area to evaluate the water quality of the upper Animas River at near-high-flow conditions. The DQO for the surface water sampling event is described in Section 4.0 of this Work Plan. The primary objective of this investigation is to evaluate the temporal and spatial variations in the water quality of the reach of the upper Animas River within the study area to characterize changes in water chemistry through time and during a range of flow conditions. Surface water sampling locations are based, in part, on the locations sampled by the USGS (Kimball, et al., 2010) in 2002 and 2003 and on the locations routinely sampled by the ARSG. These locations are shown on Figures 3-1 through 3-3.

The high-flow sampling event locations are listed and described in Table 5-3 and are shown on Figure 5-1. There are a total of 33 proposed sample locations for the high-flow sampling event. 15 of these locations are in the upper Animas River, two are in major inflows (i.e., Arrastra Creek and Boulder Creek) in the study area and 16 are located at right bank inflow locations identified by Kimball et al. (2010) and during field reconnaissance observations performed in April 2015. If the right bank inflow locations are submerged during the high flow event then a sample will be collected from the Animas River immediately downstream of the inflow location. The sample locations are identified by the measured downstream distance in meters, consistent with datum used to measure the downstream distance of the sample locations published by Kimball et al. (2010). As described in Table 5-3, many of the proposed locations have been historically sampled by the USGS or the ARSG. A brief description of each sample location and the corresponding sampling rationale are presented in Table 5-3. All proposed locations will be sampled unless insufficient water is present for collection of a representative sample(s) using the methods specified in the QAPP or access to the location is not feasible.

The surface water samples will be analyzed for the full suite of TAs listed in Table 5-1. An unfiltered and a field filtered sample will be collected at each of the sampling locations. Sample filtration methods are described in the surface water sampling SOP (Appendix C). The locations of all of the sample locations will be surveyed with a handheld GPS unit.

During the study, the data from USGS gauging station 09538000 will be used to document the stream discharge in the Animas River. Manual field discharge measurements will be performed at selected locations to the extent practical given access and health and safety considerations. Field discharge measurement methods are described in the QAPP (Appendix B).

The HASP for the high-flow surface water sampling event is included in Appendix D. In this plan, the job safety analysis (JSA) for stream monitoring describes the recommended job safe procedures. The appropriate (safest) sampling method described in the QAPP will be selected based on the JSA for surface water sampling given the conditions at each sample location.

Under no circumstances will discharge measurements and/or sample collection be performed if the conditions are determined to be unsafe.

The sample collection methods and sample handling, preservation, and custody procedures are described in the QAPP (Appendix B) and the SOPs for this investigation are included in Appendix C.

### **5.3 Opportunistic Surface Water Samples**

In addition to the proposed surface water sample locations describe above, opportunistic surface water samples may be collected during the investigation. Field water quality parameters, as listed in Table 5-1, will be measured along the reach of interest in the study area every 50 meters, as feasible. This testing frequency may be locally altered based on access conditions. If a significant change in water quality, as measured in the field, is observed a sample may be collected for laboratory analysis in an effort to further characterize changes in the water chemistry in the upper Animas River. The methods for the field water quality measurements are described in SOP No. 31, *Water Quality Meter Calibration* (Appendix C). An opportunistic sample will also be collected at the USGS Howardsville Gauging Station.

### **5.4 Schedule**

A site reconnaissance visit was conducted on April 29 and 30, 2015. The high-flow sampling event is currently planned for May 13 and 14, 2015, weather permitting.

## **6.0 REPORTING**

Upon the completion of the high-flow sampling event, a preliminary report will be prepared to briefly describe the findings of the investigation. These results will be incorporated into an annual report, which will summarize the findings from all phases of investigation conducted during 2015. This report will also include recommendations for additional investigative work.

## 7.0 REFERENCES

CDPHE, 2013. The Basic Standards and Methodologies for Surface Water, Regulation NO. 31, 5 CCR 1002-31, Colorado Department of Public Health and Environment Water Quality Control Commission. Effective January 31, 2013.

CDPHE, 2014. Classifications and Numeric Standards for San Juan River and Dolores River Basins, Regulation No. 34, 5 CCR 1002-34, Colorado Department of Public Health and Environment Water Quality Control Commission. Effective June 30, 2014

USEPA, 2002. Guidance for Quality Assurance Project Plans EPA QA/G-5. EPA 240-R-02-009. December.

Kimball, B.A., Runkel, R.L., and Walton-Day, K., 2010. An Approach to Quantifying Sources, Seasonal Change, and Biogeochemical Processes Affecting Metal Loading in Streams: Facilitating Decisions for Remediation of Mine Drainage. Applied Geochemistry 25 (2010) 728-740.

## Tables

Table 3-1

## USGS Low-Flow Surface Water Investigation - Dissolved Phase Concentrations of Chemicals of Interest

Sample Location ID	Source	Date	Time	Low-flow Discharge (cfs)	Specific Conductance ( $\mu\text{S}/\text{m}$ )	Temperature (Celsius)	pH	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Alkalinity (mg/L) as $\text{CaCO}_3$	Sulfate (mg/L)	Sulfate ICP (mg/L)	Chloride (mg/L)	Bromide (mg/L)	Silica (mg/L)	Aluminum ( $\mu\text{g}/\text{L}$ )	Arsenic ( $\mu\text{g}/\text{L}$ )
<b>Colorado Water Quality Standard<sup>1</sup></b>							<b>6.5 - 9</b>	--	--	--	--	--	--	--	--	--	--	<b>340</b>	
3655	S	8/31/02	16:30	22	320	15.5	7.77	52.5	3.21	2.29	0.70	30.22	121	116	0.74	0.05	8.35	55.5	0.15
3909	S	8/31/02	16:12	22	318	15.5	7.88	51.1	3.21	2.56	0.67	30.97	121	115	0.82	1.22	8.30	47.3	0.13
4033	RBI	8/31/02	16:30	0.04	323	9.0	8.32	52.7	3.28	3.40	0.43	74.72	78.5	73.25	1.53	0.05	9.96	157	0.20
4166	S	8/31/02	15:50	22	329	15.5	8.10	50.0	3.06	2.51	0.61	28.96	121	109	0.83	1.22	7.81	88.6	0.16
4186	LBI	8/31/02	15:51	3	239	9.5	8.05	39.8	1.96	2.39	0.54	51.85	63.2	60.16	0.17	0.05	5.62	42.2	0.17
4250	S	8/31/02	15:33	24	316	14.5	8.01	51.5	3.13	2.63	0.68	32.03	115	112	0.71	1.10	8.44	52	0.17
4300	RBI	8/30/02	13:34	--	611	8.5	7.33	106.0	8.56	4.79	1.05	35.01	265	240	10.70	0.06	11.00	21.9	0.05
4353	RBI	8/30/02	13:47	--	1,662	20.5	<b>4.48</b>	206.0	37.80	6.97	2.99	< 0.01	1,110	894	21.30	0.49	39.70	18,477	0.27
4473	S	8/31/02	15:20	25	313	15.0	7.91	49.2	3.03	2.55	0.65	32.47	114	104	0.65	1.06	7.81	44.8	0.11
4520	RBI	8/30/02	14:35	0.004	3,310	19.5	<b>4.73</b>	302.0	63.90	8.69	5.59	< 0.01	2,770	2,390	--	0.05	42.90	27,557	0.20
4544	RBI	8/30/02	14:25	25	2,500	23.0	<b>5.05</b>	268.0	52.40	9.27	4.44	< 0.01	2,060	1,940	8.07	0.05	31.10	16,420	0.30
4581	S	8/31/02	15:05	25	312	15.0	8.03	51.6	3.13	2.67	0.66	34.57	115	112	0.68	1.04	8.39	56.7	0.16
4713	S	8/31/02	14:52	26	311	15.0	7.99	50.9	3.05	2.51	0.65	32.5	115	111	0.81	1.05	7.74	51	0.16
4806	S	8/31/02	14:25	26	313	14.5	7.74	49.6	3.11	2.51	0.65	31.04	115	106	0.78	1.04	7.81	70.3	0.15
4916	S	8/31/02	14:17	26	329	14.0	7.83	51.9	3.13	2.58	0.71	33.95	118	115	0.70	1.05	8.09	56.6	0.10
4951	RBI	8/31/02	14:04	1.1	171	14.0	8.07	26.3	1.39	1.42	0.36	30.53	43.2	45.02	0.13	0.05	5.05	44.5	0.16
5016	S	8/31/02	13:58	27	310	14.0	7.90	49.0	2.92	2.42	0.68	32.41	114	104	0.69	1.00	7.52	47.7	0.14
5038	RBI	8/31/02	13:54	0.14	2,380	16.5	6.14	403.0	34.30	14.00	23.10	49.19	1,580	1,400	3.23	0.05	15.90	343	0.29
5131	S	8/31/02	13:45	27	318	14.0	7.79	51.5	3.08	2.59	0.64	33.23	115	113	0.71	0.97	7.96	63.2	0.12
5161	LBI	8/31/02	13:40	--	936	15.0	7.02	192.0	3.87	4.01	0.50	48.41	469	429	0.42	0.05	14.60	21	0.10
5221	LBI	8/31/02	13:35	--	914	13.0	7.52	183.0	3.56	3.78	0.60	42.78	450	418	0.56	0.05	13.10	13.1	0.11
5251	S	8/31/02	13:25	27	321	14.0	7.84	51.7	3.04	2.51	0.65	33.7	120	110	0.77	0.99	7.71	52.1	0.16
5295	LBI	8/30/02	15:28	28	1,897	14.0	<b>2.42</b>	59.8	13.10	2.66	0.28	--	956	754	0.68	0.05	40.00	21,212	1.33
5306	S	8/31/02	13:16	28	313	13.5	7.81	52.9	3.07	2.53	0.64	34.15	121	115	0.70	1.01	7.89	53.6	0.11
5356	RBI	8/31/02	12:48	0.56	1,728	11.5	<b>3.67</b>	263.0	21.10	6.86	1.56	< 0.01	1,100	965	1.25	0.05	34.10	13,069	0.12
5448	S	8/31/02	12:35	28	315	12.0	7.89	54.0	3.22	2.53	0.69	33.1	123	121	0.72	0.96	8.35	63	0.17
5536	S	8/31/02	12:20	28	314	11.5	7.89	53.8	3.13	2.52	0.71	33.48	123	118	0.84	0.96	7.79	56.2	0.15
5756	S	8/31/02	12:02	28	324	11.0	7.79	53.4	3.15	2.61	0.62	34.57	121	116	0.63	0.94	7.86	58.2	0.16
5858	RBI	8/30/02	16:50	0.01	661	15.0	6.19	110.0	7.27	4.64	4.11	20.68	344	321	1.39	1.44	18.10	309	0.14
5965	S	8/30/02	16:17	28	542	21.0	6.71	99.9	2.36	3.01	0.84	27.23	233	227	0.36	0.05	10.90	18.3	0.10
6038	S	8/31/02	11:42	28	319	10.5	7.78	53.7	3.09	2.57	0.59	31.51	123	120	0.76	0.95	8.13	54.8	0.19
6126	S	8/31/02	11:26	28	321	10.0	7.66	54.0	3.12	2.59	0.63	35.08	125	119	0.77	0.98	8.29	65.4	0.16
6131	LBI	8/31/02	11:17	--	638	12.0	6.88	126.0	2.93	3.58	0.71	30.76	299	279	0.59	0.11	11.10	18.6	0.08
6150	RBI	8/31/02	11:11	--	1,554	17.0	<b>5.46</b>	183.0	26.50	5.79	4.45	< 0.01	1,030	860	1.71	0.05	26.20	11,697	0.06
6265	S	8/31/02	10:53	28	333	10.0	7.79	54.5	3.24	2.52	0.64	37.34	126	118	0.79	0.96	7.96	60.3	0.11
6465	S	8/31/02	10:36	28	300	8.0	7.64	54.8	3.20	2.56	0.67	32.5	128	122	0.81	0.95	8.14	64.7	0.11
6745	S	8/31/02	10:11	28	338	8.0	7.56	53.8	3.05	2.45	0.64	34.58	127	119	0.90	0.95	7.57	59.4	0.15
6994	S	8/31/02	10:02	28	335	9.0	7.57	56.7	3.32	2.76	0.								

Table 3-1

## USGS Low-Flow Surface Water Investigation - Dissolved Phase Concentrations of Chemicals of Interest

Sample Location ID	Source	Date	Time	Low-flow Discharge (cfs)	Barium (µg/L)	Cadmium (µg/L)	Chromium (µg/L)	Cobalt (µg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)	Lithium (µg/L)	Manganese (µg/L)	Molybdenum (µg/L)	Nickel (µg/L)	Strontrium (µg/L)	Vanadium (µg/L)	Zinc (µg/L)
<b>CDPHE Water Quality Standard<sup>1</sup></b>				--	<b>2.2</b>	<b>24</b>	--	--	<b>2.7</b>	--	<b>0.5</b>	--	<b>2,179</b>	--	<b>16</b>	--	--	<b>280</b>
3655	S	8/31/02	16:30	22	26.9	0.53	0.15	0.18	<b>11.2</b>	23.2	<b>2.4</b>	5.21	206	1.35	0.47	539	0.03	185
3909	S	8/31/02	16:12	22	25.8	0.54	0.07	0.15	1.99	21.1	<b>1.07</b>	8.82	179	1.37	0.26	482	0.03	168
4033	RBI	8/31/02	16:30	0.04	6.3	0.32	0.10	0.01	0.86	1.84	<b>1.14</b>	11.3	0.09	2.1	0.07	579	0.07	71.1
4166	S	8/31/02	15:50	22	28.5	0.51	0.30	0.16	<b>7.6</b>	23.6	<b>3.22</b>	7.42	174	1.45	1.08	533	0.04	169
4186	LBI	8/31/02	15:51	3	30.6	1.33	0.08	0.003	<b>5.61</b>	5.39	<b>2.4</b>	10	475	7.94	0.1	600	0.02	210
4250	S	8/31/02	15:33	24	27.9	0.7	0.13	0.16	<b>5.04</b>	22.1	<b>3.47</b>	9.79	172	2.15	0.32	550	0.04	186
4300	RBI	8/30/02	13:34	--	18.5	1.83	0.23	0.02	<b>18.8</b>	4.52	<b>1.17</b>	28.1	11.2	0.89	1.11	1,050	0.03	<b>865</b>
4353	RBI	8/30/02	13:47	--	18.1	<b>507</b>	0.28	53	<b>4,019</b>	85.7	<b>905</b>	226	<b>59,400</b>	0.05	<b>93</b>	1,160	0.04	<b>128,000</b>
4473	S	8/31/02	15:20	25	30.2	0.67	0.10	0.14	<b>3.28</b>	19.5	<b>1.85</b>	7.16	187	2.4	0.31	568	0.03	181
4520	RBI	8/30/02	14:35	0.004	20.3	<b>385</b>	0.48	124	<b>1,039</b>	43.6	<b>61.9</b>	142	<b>781,000</b>	0.09	<b>234</b>	1,460	0.04	<b>97,400</b>
4544	RBI	8/30/02	14:25	25	19.9	<b>289</b>	0.26	55.7	<b>698</b>	45.2	<b>12.4</b>	90	<b>575,000</b>	0.06	<b>161</b>	1,370	0.05	<b>69,800</b>
4581	S	8/31/02	15:05	25	27.1	0.85	0.15	0.16	<b>12.4</b>	24.2	<b>3.36</b>	10.5	302	2.21	0.55	543	0.04	241
4713	S	8/31/02	14:52	26	28.5	0.75	0.12	0.15	<b>2.89</b>	19	<b>1.78</b>	8.26	263	2.23	0.31	527	0.03	218
4806	S	8/31/02	14:25	26	32.0	0.8	0.13	0.16	<b>6.86</b>	70	<b>3.51</b>	8.28	283	2.48	0.47	562	0.04	253
4916	S	8/31/02	14:17	26	26.1	0.8	0.16	0.16	<b>3.13</b>	21.2	<b>2.65</b>	7	798	2.08	0.44	556	0.03	249
4951	RBI	8/31/02	14:04	1.1	8.7	0.15	0.10	0.03	2.64	4.85	<b>1.06</b>	3.2	556	1.38	0.1	247	0.03	84.1
5016	S	8/31/02	13:58	27	31.0	0.82	0.12	0.16	<b>3.4</b>	20.4	<b>1.8</b>	8.2	434	2.43	0.38	537	0.03	260
5038	RBI	8/31/02	13:54	0.14	28.0	<b>13.7</b>	0.22	48.8	<b>19.6</b>	1,290	<b>14.1</b>	37.6	<b>224,000</b>	1.37	<b>38</b>	2,920	0.03	<b>12,400</b>
5131	S	8/31/02	13:45	27	28.7	0.83	0.14	0.21	<b>9.63</b>	27.9	<b>3.55</b>	7.66	607	2.17	0.44	513	0.03	265
5161	LBI	8/31/02	13:40	--	33.8	<b>5.03</b>	0.15	0.04	2.57	6.49	<b>1.6</b>	8.4	71.2	4.76	0.72	1,661	0.02	<b>1,070</b>
5221	LBI	8/31/02	13:35	--	40.1	<b>14.9</b>	0.12	0.06	1.12	8.7	<b>1.54</b>	8.06	22.3	7.61	0.74	1,548	0.09	<b>3,290</b>
5251	S	8/31/02	13:25	27	26.7	0.96	0.15	0.18	<b>3.45</b>	19.1	<b>1.56</b>	6.38	592	2.14	0.37	510	0.03	259
5295	LBI	8/30/02	15:28	28	16.0	<b>11.8</b>	4.65	146	<b>692</b>	163,000	<b>525</b>	41	<b>7,280</b>	0.42	<b>106</b>	628	0.4	<b>2,960</b>
5306	S	8/31/02	13:16	28	26.9	0.98	0.11	0.22	<b>3.07</b>	19.9	<b>2.52</b>	8.1	616	2.02	0.37	502	0.03	<b>283</b>
5356	RBI	8/31/02	12:48	0.56	14.8	<b>48.6</b>	0.14	91.8	<b>1,007</b>	18,900	<b>1,105</b>	69.1	<b>89,700</b>	< 0.01	<b>53.5</b>	2,880	0.01	<b>17,300</b>
5448	S	8/31/02	12:35	28	26.6	1.18	0.14	0.37	<b>4.36</b>	25.4	<b>2.31</b>	3.38	820	2.15	0.53	546	0.03	<b>363</b>
5536	S	8/31/02	12:20	28	30.2	1.15	0.12	0.33	<b>5.19</b>	23.7	<b>2.09</b>	7.71	718	2.27	0.48	538	0.03	<b>389</b>
5756	S	8/31/02	12:02	28	26.2	1.12	0.13	0.35	<b>3.88</b>	22.2	<b>1.65</b>	8.4	765	2.16	0.51	585	0.03	<b>374</b>
5858	RBI	8/30/02	16:50	0.01	11.2	<b>21</b>	0.27	0.14	<b>68.5</b>	2.02	0.36	53.8	<b>21,900</b>	0.06	<b>24.1</b>	964	0.02	<b>4,440</b>
5965	S	8/30/02	16:17	28	50.8	<b>0.39</b>	0.12	0.02	2.55	6.69	0.24	6.34	11.8	0.76	0.69	1,143	0.03	189
6038	S	8/31/02	11:42	28	25.9	1.14	0.12	0.31	<b>3.49</b>	20	<b>3.02</b>	6.39	718	1.99	0.53	551	0.02	<b>361</b>
6126	S	8/31/02	11:26	28	26.7	1.21	0.11	0.3	<b>3.61</b>	20.5	<b>4.2</b>	6.54	783	2.01	0.53	551	0.02	<b>381</b>
6131	LBI	8/31/02	11:17	--	37.1	1.33	0.15	0.33	1.84	2.86	0.44	7.12	129	1.45	0.38	1,626	0.03	<b>493</b>
6150	RBI	8/31/02	11:11	--	29.4	<b>89.8</b>	0.12	151	<b>444</b>	13,000	<b>414</b>	70.4	<b>177,000</b>	0.16	<b>98.5</b>	1,540	0.01	<b>23,100</b>
6265	S	8/31/02	10:53	28	24.8	1.27	0.15	0.51	<b>3.74</b>	20.4	<b>1.12</b>	7.5	1,080	1.88	0.72	530	0.02	<b>425</b>
6465	S	8/31/02	10:36	28	27.0	1.34	0.13	0.56	<b>4.42</b>	39.6	<b>2.19</b>	8.2	1,260	2.01	0.77	539	0.03	<b>450</b>
6745	S	8/31/02	10:11	28	30.2	1.42	0.11	0.55	<b>4.14</b>	35.4	<b>1.49</b>	7.18	1,170	2.25	0.9	570	0.02	<b>438</b>
6994	S	8/31/02	10:02	28	25.0	1.37	0.09	0.63	<b>5.6</b>	89.1	<b>2.3</b>	8.85	1,230	1.96	1.44			

Table 3-2

## USGS High-Flow Surface Water Investigation - Dissolved Phase Concentrations of Chemicals of Interest

Sample Location ID	Date and Time	Source	Discharge (cfs)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Bromide (mg/L)	Sulfate, ICP (mg/L)	Silica (mg/L)	Aluminum (µg/L)	Arsenic (µg/L)	Barium (µg/L)	Cadmium (µg/L)
<b>Colorado Water Quality Standard<sup>1</sup></b>			--	--	--	--	--	--	--	--	--	--	--	<b>340</b>	--	<b>2.2</b>
4166	4/16/03 13:00	S	46	45.3	2.79	2.21	0.59	92.8	1.34	1.29	94.5	6.26	70.3	0.19	24.9	0.89
4916	4/17/03 8:50	S	49	44.2	2.78	2.31	0.49	98.4	1.27	1.19	88.9	6.40	50.2	0.09	25.1	1.63
5536	4/17/03 12:14	S	51	51.9	2.74	2.25	0.48	103.0	1.21	1.15	88.6	6.25	75.6	0.10	23.6	1.58
6745	4/17/03 9:17	S	55	47.0	2.96	2.31	0.60	109.0	1.19	1.07	100.0	6.65	47.3	0.08	23.4	2.06
7306	4/17/03 11:29	S	53	46.7	3.05	2.35	0.57	111.0	1.17	1.10	107.0	6.77	55.0	0.09	24.1	2.16
7858	4/17/03 1:00	S	66	46.2	2.87	2.22	0.64	111.0	1.48	1.11	99.2	6.45	24.0	0.12	21.1	2.15

Sample Location ID	Date and Time	Source	Discharge (cfs)	Chromium (µg/L)	Cobalt (µg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)	Lithium (µg/L)	Manganese (µg/L)	Molybdenum (µg/L)	Nickel (µg/L)	Silver (µg/L)	Strontium (µg/L)	Vanadium (µg/L)	Zinc (µg/L)
<b>CDPHE Water Quality Standard<sup>1</sup></b>			<b>24</b>	--	<b>2.7</b>	--	<b>0.5</b>	--	<b>2,179</b>	--	<b>16</b>	<b>0.03</b>	--	--	<b>280</b>	
4166	4/16/03 13:00	S	46	0.03	0.39	2.60	19.90	<b>0.57</b>	5.80	988	1.33	0.51	0.004	444	0.05	490
4916	4/17/03 8:50	S	49	0.10	0.42	<b>10.40</b>	6.64	<b>0.71</b>	5.82	611	1.54	0.61	0.002	453	0.02	526
5536	4/17/03 12:14	S	51	0.08	0.61	<b>6.16</b>	15.20	0.50	5.97	903	1.68	0.65	0.002	429	0.02	652
6745	4/17/03 9:17	S	55	0.02	0.84	<b>4.66</b>	7.18	0.13	5.86	1,400	1.48	1.07	0.001	462	0.01	676
7306	4/17/03 11:29	S	53	0.13	0.82	<b>5.18</b>	12.60	0.20	6.19	1,500	1.44	1.16	0.001	493	0.01	667
7858	4/17/03 1:00	S	66	0.06	1.26	<b>3.24</b>	4.11	0.11	6.64	1,720	1.43	1.28	0.002	471	0.02	726

Notes:

1. Colorado Department of Public Health and Environment (CDPHE), 2014. Standards are stated as dissolved phase (e.g., filtered with a 0.45 micron filter).

If there is more than one dissolved phase standard then the lowest standard was used, excluding calculated hardness based table value standards.

2. -- = not applicable / not available

3. **BOLD** Concentration exceeded noted Colorado Water Quality Standard

4. S = Stream

5. mg/L = milligrams per liter

6. µg/L = micrograms per liter

7. CaCO<sub>3</sub> = calcium carbonate

8. Samples were field filtered with a 0.45 micron filter

**Table 3-3****Animas River USGS Guaging Station 09358000 Mean Monthly Discharge**

Year	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
	Mean Monthly Discharge in cfs											
1991	--	--	--	--	--	--	--	--	--	33.4	27	18.9
1992	13.8	15.7	18.6	66.4	304.2	403	195.9	84.5	55.8	33.4	27	19.3
1993	16.3	16.5	21.6	39.6	383.1	618	328.4	125.5	89.8	--	--	--
1994	--	--	--	--	--	--	--	--	--	73.8	44.8	35.7
1995	33.8	36.1	43.3	50	146.8	783.2	734.5	252.8	87.4	51.7	35.1	27.5
1996	30.1	31.8	30.3	69.4	453.6	428.3	122.3	44.4	53	83.5	45.4	35.6
1997	30.7	30.1	42.5	67.9	310	794	385.1	182.3	126.5	136.4	64.9	41.4
1998	33.7	25.9	29.9	43.4	250	443	272.6	80.4	58.8	61.3	49.1	34.2
1999	24.8	23.9	27.7	53.9	233.9	694.7	362.9	222.7	131.1	48.9	22.7	28.6
2000	22.3	17.1	20.3	92.9	412.5	348	76.9	65.3	77	61.3	40.6	31.6
2001	29.5	21.5	24.9	83.6	406	483.4	169.9	94.1	42.2	30.4	21.2	20.4
2002	20.4	18.6	23.9	77.1	178.9	128.1	30.5	28	54.1	55	32.4	22.2
2003	19.6	17.2	19.3	57	351.1	354.6	89.1	58.5	100.9	41.9	25.2	17.3
2004	14.4	16.1	44	72.7	351	428.4	142.1	46.5	94.9	67.5	37.5	32.9
2005	31.7	30.7	35.5	80.4	430.7	538.2	262.7	92.1	47	111.4	41.6	30.2
2006	30.9	30.5	43.1	101.2	398.8	384.4	135.8	113.5	80.6	189.6	53	31.8
2007	24.7	21.9	52.3	78.4	357.2	545.3	178.3	128.8	99.8	97	41.4	32.7
2008	33.6	33.2	32.7	69.8	274.4	716.9	355	100.7	54	32.7	24.2	21.5
2009	27.4	21.1	41.9	121.4	624.6	394.2	157.8	47.5	40.8	31.8	25.2	26.4
2010	30.1	28.1	32.4	91.9	370.2	453.4	94.2	98.1	48.4	43.4	36.8	26.4
2011	25.8	21.6	21.4	53	155.5	715.5	364.8	93.2	51.9	46.8	31.3	25
2012	25	25.1	40.7	140.1	290.1	185.6	62.7	43.5	31	23.2	18.4	15.8
2013	13.4	13.8	16.1	44.1	330.3	206.3	66.5	104.1	151.9	94	51.4	32.2
2014	26.1	23.2	26.4	92.1	318.9	666.4	229.8	89.7	98.1	--	--	--
Mean of Montly Discharge	25	24	31	75	333	487	219	100	76	66	66	66
Std Deviation	6.6	6.5	10.3	25.2	107.7	189.9	159.9	56.8	32.7	40.3	15.4	10.2
Min	13.4	13.8	16.1	39.6	146.8	128.1	30.5	28.0	31.0	23.2	18.4	15.8
Max	33.8	36.1	52.3	140.1	624.6	794.0	734.5	252.8	151.9	189.6	64.9	41.4

Notes:

1. Source: [http://waterdata.usgs.gov/nwis/monthly?referred\\_module=sw&site\\_no=09358000&por\\_09358000\\_13=345985,00060,13,1991-10,2014-11&format=html\\_table&date\\_format=MM/DD/YYYY&rdb\\_compression=file&submitted\\_form=parameter\\_selection\\_list](http://waterdata.usgs.gov/nwis/monthly?referred_module=sw&site_no=09358000&por_09358000_13=345985,00060,13,1991-10,2014-11&format=html_table&date_format=MM/DD/YYYY&rdb_compression=file&submitted_form=parameter_selection_list)
2. USGS - United States Geological Survey
3. cfs = cubic feet per second
4. -- = data not available

Table 5-1

## Target Analytes

Target Analyte	Total Recoverable (Y/N)	Dissolved (Y/N)	Laboratory Analytical Method	Colorado Water Quality Standard <sup>1</sup> ( $\mu\text{g/L}$ )	
<i>Laboratory Parameters</i>				Dissolved	Total Recoverable
<b>Metals</b>					
Aluminum	Y	Y	200.8	--	750 ac/ch
Arsenic	Y	Y	200.8	340 ac	100 ch
Barium	Y	Y	200.8	--	--
Cadmium	Y	Y	200.8	See Table 5-2	--
Calcium	Y	Y	200.7	--	--
Chromium	Y	Y	200.8	Cr <sup>III</sup> TVS <sup>2</sup> = 183 ac / 24 ch	Cr <sup>III</sup> = 100 ch
Cobalt	Y	Y	200.8	--	--
Copper	Y	Y	200.8	TVS <sup>2</sup> = 3.6 ac / 2.7	--
Iron	Y	Y	200.7	--	1000 ch
Lead	Y	Y	200.8	TVS <sup>2</sup> = 14 ac / 0.5 ch	--
Lithium	Y	Y	200.7	--	--
Magnesium	Y	Y	200.7	--	--
Manganese	Y	Y	200.8	See Table 5-2	--
Molybdenum	Y	Y	200.8	--	160 ch
Nickel	Y	Y	200.8	TVS <sup>2</sup> = 145 ac / 16 ch	--
Potassium	Y	Y	200.7	--	--
Silica	Y	Y	200.7	--	--
Silver	Y	Y	200.8	TVS <sup>2</sup> = 0.19 ac / 0.01 ch trout / 0.03 ch	--
Sodium	Y	Y	200.7	--	--
Strontium	Y	Y	200.7	--	--
Vanadium	Y	Y	200.8	--	--
Zinc	Y	Y	200.8	See Table 5-2	--
<b>Anions</b>					
Bromide	N	Y	300.0	--	--
Chloride	N	Y	300.0	--	--
Sulfate	N	Y	300.0	--	--
Fluoride	N	Y	300.0	--	--
<b>Misc.</b>					
Hardness	Y	--	SM2340B	--	--
Alkalinity	Y	--	SM 2320B	--	--
TSS	Y	--	SM2540D	--	--
TDS	Y	--	SM2540C	--	--
<b>Field Parameters</b>					
Temperature	--	--	--	--	--
Turbidity	--	--	--	--	--
pH	--	--	--	6.5 - 9	--
Specific Conductance	--	--	--	--	--
DO	--	--	--	6,000	--
ORP	--	--	--	--	--

## Notes:

1. Colorado Department of Public Health and Environment (CDPHE) 2014. Standards are stated as dissolved phase (e.g., filtered with a 0.45 micron filter). If there is more than one standard then the lowest standard was used.

2. TVS = table value standard. Calculated using a mean hardness of 25 mg/L calcium carbonate CDPHE (2013)

3. -- = not applicable

4. Y = Yes

5. N = No

6. DO = dissolved oxygen

7. ORP = oxidation reduction potential

8. TSS = Total suspended sediments

9. TDS = Total dissolved solids

10. ac = acute

11. ch = chronic

**Table 5-2**  
**Animas River Basin**  
**Aquatic Life Indicator Goal: Brook Trout**

**Segment 3a**  
**Acute Standards (µg/L)**

Metal	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Zinc	720	780	1060	1200	760	410	280	340	380	440	510	590

**Chronic Standards (µg/L)**

Metal	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Cadmium	TVS	TVS	TVS	3.5	2.2	TVS						
Manganese	TVS	TVS	2571	2179	TVS							
Zinc	720	780	1060	1200	760	410	280	340	380	440	510	590

Notes:

1. Source: [ftp://ft.dphe.state.co.us/wqc/wqcc/Current Water Quality Standards/Currently Effective Standards/34\\_SanJuan\\_Effective\\_03-01-2015/](ftp://ft.dphe.state.co.us/wqc/wqcc/Current Water Quality Standards/Currently Effective Standards/34_SanJuan_Effective_03-01-2015/)  
CDPHE, 2014
2. TVS = Table Value Standards: CDPHE Water Quality Control Commission Regulation No. 31. Table IV (CDPHE, 2013)
3. µg/L = milligrams per liter

Table 5-3

## Proposed High-Flow Surface Water Investigation Sample Locations

Sample Location ID (meters)	UTM X	UTM Y	Alias			Source Type	Source Name	Concentration Data Source <sup>1</sup>	Zinc (µg/L)	Cadmium (µg/L)	Manganese (µg/L)	Location Description	Rationale
	NAD 83 UTM Zone 13 N	ARSG	USGS Database	Kimball et al. (2010)									
4023	269038.1481	4189934.798	A56	AMIN-4023	--	S	Animas River	ARSG	360	1.80	--	At Animas River Stakeholder Group location A56; right bank access via gravel road	Background surface water sample location; furthest upstream sample location
4166	268872.2972	4189923.073	--	AMIN-4166	4166	S	Animas River	Kimball et. al (2010)	490	0.89	988	At Kimball et. al (2010) low-flow and high-flow in-stream sample location 4166; Kimball et. al (2010) Transport site T1; upstream from Arrastra Creek; right bank access via gravel road; limited left bank access	At Kimball et. al (2010) low-flow/high-flow in-stream sample location 4166, which exceeded the zinc water quality standard; immediately upstream of the confluence of the Animas River and Arrastra Creek; upstream of Mayflower Tailings Impoundments and Mill
A58-SS	268920.6218	4189829.915	A58	--	--	LBI	Arrastra Creek	ARSG	187.6	1.64	<10	At Animas River Stakeholder Group location A58; in Arrastra Creek upstream of the confluence with the Animas River	Arrastra Creek; approx. 230 feet upstream of confluence with Animas River
4220	268828.1976	4189877.948	A60	--	--	S	Animas River	ARSG	320	1.9	--	At Animas River Stakeholder Group location A60; right bank access via boat ramp immediately downstream of bridge on Colorado Road 52; left bank access by crossing the bridge	At Animas River Stakeholder Group location A60; zinc concentration of 320 µg/L exceeded water quality standard; adjacent to Mayflower Mill
4353C	268723.5372	4189904.94	--	--	4353	RBI	--	Kimball et. al (2010)	128,000	507	59,400	Stream level spring, At Kimball et. al (2010) right bank inflow sample location 4353; aluminum oxide colored water; right bank access via gravel road	Adjacent to eastern end of Tailings Impoundment 1; historical zinc, cadmium, and manganese concentrations exceeded their respective water quality standards at Kimball et. al (2010) right bank inflow location 4353 during the 2002 low-flow sampling event; aluminum oxide colored water; adjacent to Tailings Impoundment 1
4353A	268720.8779	4189916.045	--	--	--	RBI	Pipe	--	--	--	--	Inflow from pipe on right bank; right bank access via gravel road	Inflow from pipe on right bank; adjacent to Tailings Impoundment 1
4353B	268717.1483	4189900.115	--	--	--	S	Animas River	--	--	--	--	In stream sample; Immediately downstream of pipe inflow and seep inflow; right bank access via gravel road; limited left bank access	In stream sample; immediately downstream of pipe inflow and seep inflow; adjacent to Tailings Impoundment 1
4520	268593.6929	4189804.795	--	4520	--	RBI	--	USGS	97,400	385	781,000	At Kimball et. al. (2010) low-flow sample location 4520; Marshy ponds with algae near manganocrete	At Kimball et. al (2010) low-flow right bank inflow location 4520; maximum to near maximum Zn, Cd, and Mn concentrations in 2002, all of which exceeded regulatory water quality standards; adjacent to Tailings Impoundment 1
4581	268564.1576	4189780.655	A61	AMIN-4581	--	S	Animas River	ARSG	1,038	2.78	923	At Animas River Stakeholder Group location A61; upstream of Boulder Creek; right bank access via gravel road; limited left bank access	At Animas River Stakeholder Group location A61; historical zinc and cadmium concentrations exceeded their respective water quality standards at A61; immediately downstream of Kimball et. al (2010) right bank inflow locations 4520 where elevated Zn, Cd, and Mn concentrations were observed in 2003, above regulatory standards; adjacent to Tailings Impoundment 1
4656	268473.1001	4189759.847	--	AMIN-4656	--	S	Animas River	--	--	--	--	Upstream for Pinicle Gap; right bank access via gravel road; limited left bank access	Downstream of Kimball et. al (2010) right bank inflow locations 4520 and 4544 where elevated Zn, Cd, and Mn concentrations were observed in 2002, above regulatory standards; adjacent to Tailings Impoundment 1
4734	268391.5023	4189771.061	--	--	--	RBI	Mine Adit	--	--	--	--	At observed mine adit; access via gravel road	At observed mine adit; adjacent to Tailings Impoundment 1
4749	268380.1263	4189750.496	--	--	--	S	Animas River	--	--	--	--	Immediately downstream of observed mine adit; right bank access via gravel road; limited left bank access	Immediately downstream of observed mine adit; adjacent to Tailings Impoundment 1
4916	268284.3982	4189652.885	--	AMIN-4916	4916	S	Animas River	Kimball et. al (2010)	526	1.63	611	At Kimball et. al (2010) low-flow and high-flow in-stream sample location 4916; Kimball et. al (2010) Transport site T2 (low flow)/T3 (high-flow); immediately upstream from the road culverts for Boulder Creek; right bank access via gravel road; limited left bank access	At Kimball et. al (2010) low-flow and high-flow in-stream sample location 4916; high-flow zinc concentration 482 µg/L in 2003, which is above the water quality standard; Kimball et al. (2010) reported acid drainage inflows; at southern end of Tailings Impoundment 1
4951	268207.7354	4189647.238	A62	AMIN-4951	4951	RBI	Boulder Creek	ARSG	980	3.9	2,770	At Kimball et. al (2010) low-flow right bank sample location 4951 and Animas River Stakeholder Group location A62; on right bank of the Animas River; at confluence of Boulder Creek and Animas River; immediately downstream of where boulder creek flows across gravel road; access via gravel road	Boulder Creek bisects Tailings Impoundments 1 and 2; at Kimball et. al (2010) low-flow right bank sample location 4951 and Animas River Stakeholder Group location A62; historical Zn, Cd, and Mn concentrations exceeded their respective water quality standards at A62
5000	268167.5145	4189596.365	--	--	--	RBI	--	--	--	--	--	At observed right bank inflow; red colored water; access via gravel road	At observed right bank inflow; red colored water; adjacent to Tailings Impoundment 2

Table 5-3

## Proposed High-Flow Surface Water Investigation Sample Locations

Sample Location ID (meters)	UTM X	UTM Y	Alias			Source Type	Source Name	Concentration Data Source <sup>1</sup>	Zinc (µg/L)	Cadmium (µg/L)	Manganese (µg/L)	Location Description	Rationale
	NAD 83 UTM Zone 13 N	ARSG	USGS Database	Kimball et al. (2010)	CDPHE Water Quality Standard <sup>11</sup>								
5038	268162.1685	4189528.661	--	--	--	RBI	--	Kimball et. al (2010)	12,400	13.7	224,000	At Kimball et. al (2010) low-flow sample location 5038; right bank access via gravel road; limited left bank access	At Kimball et. al (2010) low-flow sample location 5038; substantial orange precipitate in inflow noted by Kimball et. al (2010) in 2002; zinc, cadmium, and manganese concentrations exceeded their respective water quality standards at 5038 during the 2002 low-flow sampling event; substantial orange precipitate in inflow noted by Kimball et al (2010); adjacent to Tailings Impoundment 2
5306	268068.6541	4189433.518	A64	AMIN-5306	--	S	Animas River	ARSG	350	1.2	230	At Animas River Stakeholder Group location A64; right bank access via gravel road; limited left bank access	At Animas River Stakeholder Group location A64; historical zinc concentration exceeded the water quality standard at A64; adjacent to Tailings Impoundment 2
5356	267936.8894	4189433.067	--	--	--	RBI	--	USGS	17,300	48.6	89,700	At Kimball et. al. (2010) low-flow right bank inflow sample location 5356; discharge from slough draining tailings; right bank access via gravel road	At Kimball et. al. (2010) low-flow right bank inflow sample location 5356; Zn, Cd, and Mn concentrations exceeded their respective water quality standards at 5356 during the 2002 low-flow sampling event; adjacent to Tailings Impoundment 2
5608	267706.3855	4189329.224	--	--	--	RBI	--	--	--	--	--	At right bank inflow; drainage from Tailings Impoundment 2 area; right bank access via Colorado Road 2	Inflow from drainage from Tailings Impoundment 2 area; between Tailings Impoundments 2 and 3
5858	267522.5569	4189215.853	--	AMIN-5858	5858	RBI	--	Kimball et. al (2010)	4,440	21	21,900	At Kimball et. al (2010) low-flow sample location 5858; small pool near stream; right bank access via Colorado Road 2	At Kimball et. al (2010) right bank inflow low-flow sample location 5858; zinc, cadmium, and manganese concentrations exceed their respective water quality standards at 5858 during the 2002 low-flow sampling event; upstream of Tailings Impoundment 4
5938	267458.208	4189159.896	A65	--	--	S	Animas River	ARSG	430	1.1	400	At Animas River Stakeholder Group location A65; right bank access via Colorado Road 2; limited left bank access	At Animas River Stakeholder Group location A65; historical zinc concentrations exceeded the water quality standard at A65; adjacent to Tailings Impoundment 4
6013	267401.9286	4189131.338	--	--	--	RBI	Spring	--	--	--	--	Downstream of spring near metal building; access via Colorado Road 2; on private property	Downstream of spring prior to confluence with Animas River; ; adjacent to Tailings Impoundment 4
6150	267297.4363	4189051.115	--	--	6150	RBI	--	USGS	23,100	89.8	177,000	At USGS low-flow sample location 6150; Red stained right bank discharge	At USGS low-flow sample location 6150; USGS noted red stained right bank discharge during 2002 sampling event; Zn, Cd, Mn concentrations exceed their respective water quality standards at 6150 during the 2002 low-flow sampling event; adjacent to Tailings Impoundment 4
6215	267236.5137	4189015.142	--	--	--	RBI	--	--	--	--	--	Right bank inflow seep; red stained water, right bank access via Colorado Road 2	Right bank seep with red stained water; adjacent to Tailings Impoundment 4
6274	267186.6861	4188983.203				S	Animas River	--	--	--	--	In Animas river immediately downstream of right bank inflow seep with red stained water; right bank access via Colorado Road 2	Immediately downstream of right bank inflow seep with red stained water; adjacent to Tailings Impoundment 4
6528	266977.1348	4188846.89	--	AMIN-6528	--	S	Animas River	--	--	--	--	Upstream from former Lacawana Bridge; right bank access via Colorado Road 20; limited left bank access	Adjacent to the western end of tailings impoundment 4; approximately downstream from 830 feet downstream of right bank inflow seep with red stained water; adjacent to Tailings Impoundment 4
3	266752.12	4188826.24	--	--	--	RBI	Pond	--	--	--	--	In pond upgradient of reactive treatment wall; right bank access via Colorado Road 20	In pond upgradient of reactive treatment wall
6768	266767.5664	4188733.792	A66	AMIN-6768	--	S	Animas River	Kimball et. al (2010)	676	2.06	1,400	Near Kimball et. al (2010) low-flow and high-flow in-stream sample location 6745 and Animas River Stakeholder Group location A66; at former Lacawana Bridge; right bank access via Colorado Road 20; limited left bank access	At Kimball et. al (2010) low-flow and high-flow in-stream sample location 6745; high-flow zinc concentration 585 µg/L in 2003, which is above the water quality standard; at Stakeholder site A66; downstream of the permeable reactive barrier located along the gravel road on the right bank
6879	266644.695	4188730.279				RBI	Wetland					Right bank inflow at wetland near campground	Right bank inflow at wetland area
7049	266505.1236	4188664.358	--	--	7049	RBI	--	Kimball et. al (2010)	9,340	45.4	9,570	At Kimball et. al (2010) low-flow sample location 7049; in braid of Animas River during April 29, 2015 recon; right bank access via gravel road; limited left bank access	At Kimball et. al (2010) right bank inflow low-flow sample location 7049; zinc, cadmium, and manganese concentrations exceed their respective water quality standards at 7049 during the 2002 low-flow sampling event
7688	266012.5664	4188355.906	--	AMIN-7688		S	Animas River	--	--	--	--	At USGS sample location AMIN-7688; right bank access via E 16th Street; limited left bank access	At USGS sample location AMIN-7688; upstream of right bank inflow 7690
7690	266002.0012	4188355.3	--	--	7750	RBI	--	Kimball et. al (2010)	7,370	39.7	73,300	Approx. 60 meters upstream from Kimball et. al (2010) right bank inflow low-flow sample location 7750; during 4/30/2015 recon event 7750 was part of the main Animas River channel; ditch draining from pond; right bank access via Animas Street; left bank access via CO Road 32	Approx. 60 meters upstream from Kimball et. al (2010) right bank inflow low-flow sample location 7750; Zn, Cd, and Mn concentrations exceed their respective water quality standards at 7750 during the 2002 low-flow sampling event

Table 5-3

## Proposed High-Flow Surface Water Investigation Sample Locations

Sample Location ID (meters)	UTM X	UTM Y	Alias			Source Type	Source Name	Concentration Data Source <sup>1</sup>	Zinc (µg/L)	Cadmium (µg/L)	Manganese (µg/L)	Location Description	Rationale
	NAD 83 UTM Zone 13 N	ARSG	USGS Database	Kimball et al. (2010)	CDPHE Water Quality Standard <sup>11</sup>								
7858	265912.1895	4188191.806	A68	AMIN-7858	7858	S	Animas River	ARGS	1,900	6.2	4,100	At Kimball et. al (2010) low-flow and high-flow sample location 7858 and Animas River Stakeholder Group location A68; Kimball et. al (2010) Transport site T3 (low flow)/T7 (high flow) – at 14th Street bridge with Kimball et. al (2010) stream gauge	At Kimball et. al (2010) low-flow and high-flow sample location 7858 and Animas River Stakeholder Group location A68; historical concentrations of zinc, cadmium, and manganese exceed their respective water quality standards at A68; furthest downstream sample location

Notes:

1. USGS = data from United States Geological Survey (Kimball et al., 2010)

2. ARSG = data from Animas River Stakeholders Group database (<http://www.animasriverstakeholdersgroup.org/page11.html>)

3. Sample results are representative of the date when the maximum historical zinc concentration was reported.

4. µg/L = Micrograms per liter

5. ft = feet

6. **BOLD** Concentration exceeded noted Colorado Water Quality Standard

7. S = Stream

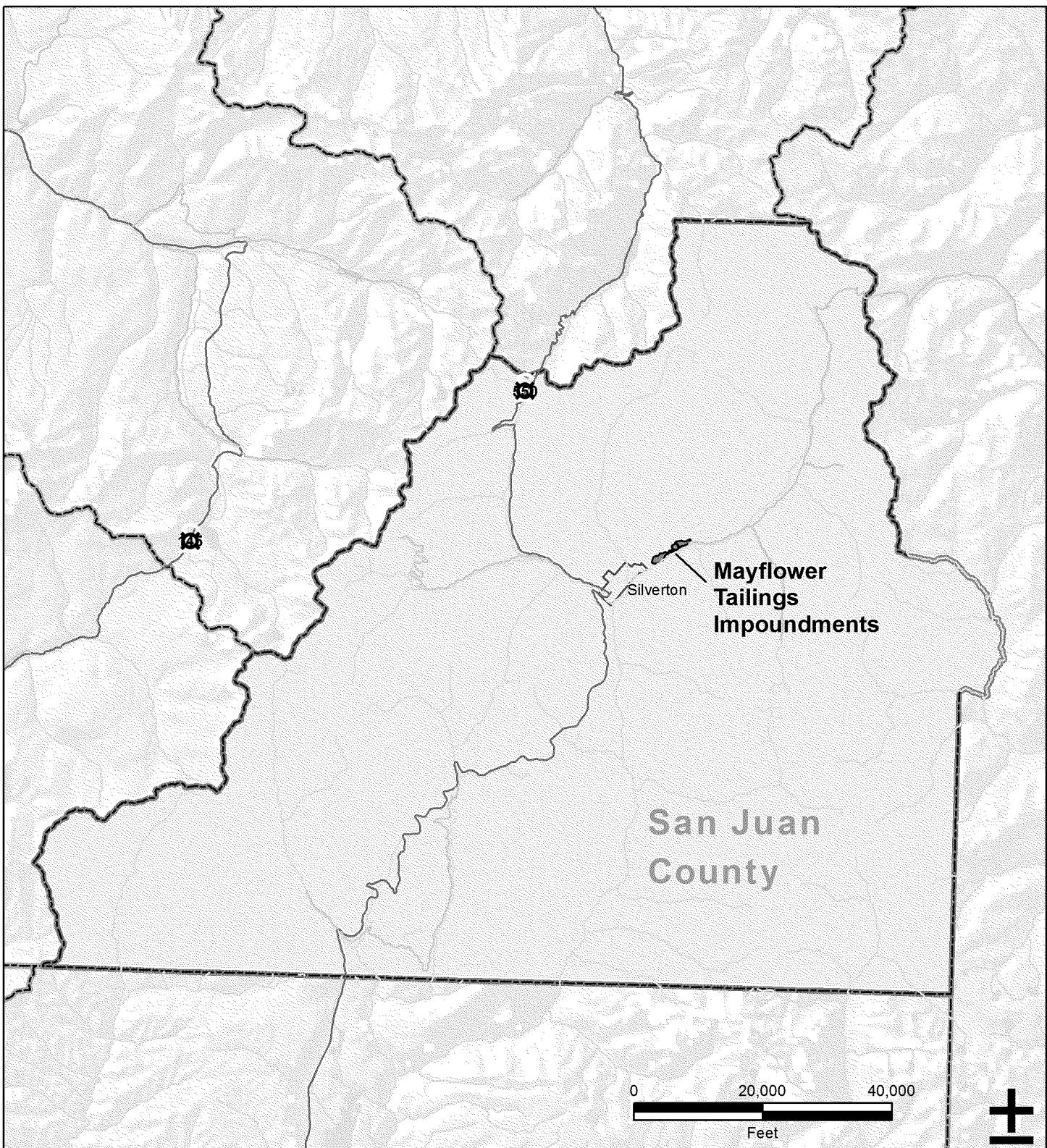
8. RBI = Right Bank Inflow

9. LBI = Left Bank Inflow

10. &lt;10 = concentration below noted laboratory reporting limit

11. See Table 5-2; the lowest standard reported was selected, not including table value standards

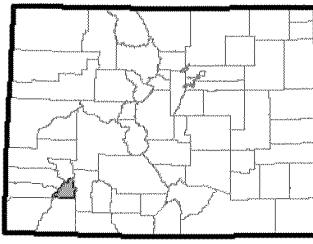
# **Figures**



### Legend

- Roads
- Highways
- Silverton, CO
- Mayflower Tailings Impoundments
- Counties

Location of The Sunnyside Mine  
in San Juan County, Colorado



### SUNNYSIDE GOLD SILVERTON, CO

FIGURE 1-1

#### SITE LOCATION MAP

DATE: MAY 08, 2015

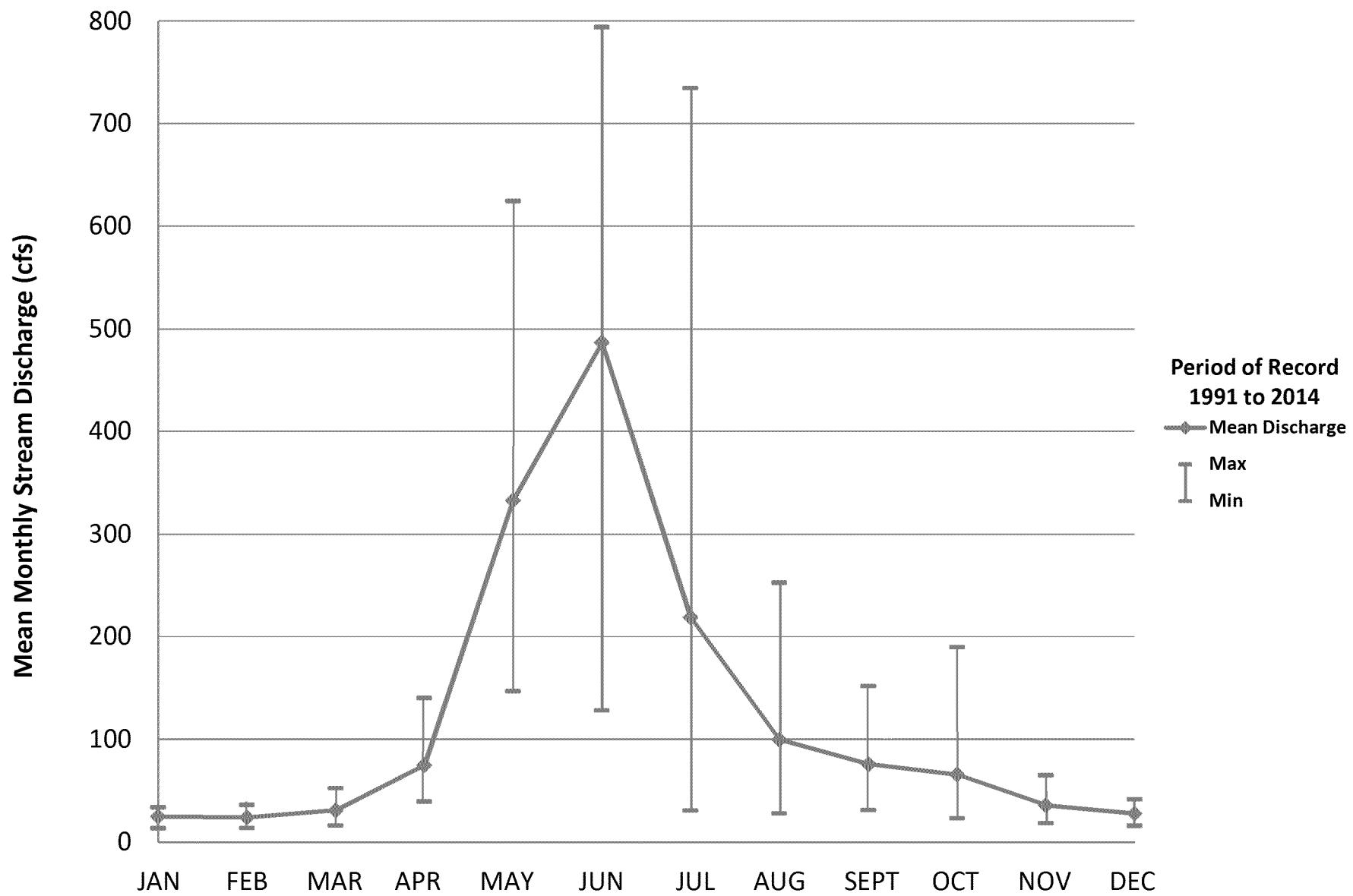
BY: DKG FOR: BGH

FORMATION  
ENVIRONMENTAL





**Figure 3-2 - Animas River USGS Stream Gauging Station 09358000 Hydrograph**  
ARSG Sample Location A68





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## **Appendix A – Animas River Stakeholder Group Surface Water Sample Results – Chemicals of Interest**

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Alkalinity	Total Aluminum	Dissolved Aluminum	Total Silver	Dissolved Silver	Total Silver	Dissolved Arsenic	Total Boron	Dissolved Boron	Dissolved Bromine	Total Antimony	Dissolved Antimony	Total Barium	Dissolved Barium	Total Beryllium	Dissolved Beryllium
		mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
<b>CDPHE Water Quality Standard<sup>1</sup></b>	--	--	--	--	--	--	340	--	--	--	--	--	--	--	--	--	--
A56	9/9/1991	--	72.0	ND	<.2	<.2	--	--	--	--	--	--	--	--	--	--	--
A56	6/25/1992	--	--	ND	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A56	10/15/1992	--	--	ND	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A56	9/2/1998	--	119.0	59.0	ND	<.2	1	<1	--	--	--	ND	ND	27	25	ND	ND
A56	6/24/1999	--	795.0	ND	ND	<.2	1.8	<1	--	--	--	ND	ND	22.7	15.9	ND	ND
A58	9/9/1991	--	ND	ND	<.2	<.2	ND	--	--	--	--	--	--	--	--	--	--
A58	6/25/1992	--	--	ND	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A58	10/15/1992	--	--	ND	--	<.2	--	<1	--	--	--	--	--	--	--	--	--
A58	9/2/1998	--	88.0	ND	ND	<.2	ND	<1	--	--	--	ND	ND	25	22	ND	ND
A58	6/22/1999	--	ND	ND	ND	<.2	ND	<1	--	--	--	ND	ND	13.7	13.3	ND	ND
A58	7/28/2002	44	<15	<15	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A58	9/3/2002	46	<15	<15	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A58	6/12/2003	--	18.0	<15	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A58	10/19/2003	--	<15	<15	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A58	6/10/2004	26	23.0	<15	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A58	6/19/2004	--	28.0	15.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A58	8/10/2009	50	--	--	--	<.3	--	--	--	--	--	--	--	--	--	--	--
A58	10/26/2009	52	--	--	--	<.3	--	--	--	--	--	--	--	--	--	--	--
A58	4/13/2010	48	--	--	--	<.3	--	--	--	--	--	--	--	--	--	--	--
A58	7/7/2010	56	--	--	--	<.3	--	--	--	--	--	--	--	--	--	--	--
A60	9/9/1991	--	70.0	ND	<.2	<.2	--	--	--	--	--	--	--	--	--	--	--
A60	6/25/1992	--	--	ND	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A60	10/15/1992	--	--	52.0	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A60	7/20/1993	--	--	ND	--	--	--	--	--	--	--	--	--	--	--	--	--
A60	4/6/1999	--	0.0	<40	--	--	0.0	0.0	--	--	--	--	--	0.0	20.7	0.0	<1
A60	4/27/1999	--	0.0	<40	--	--	0.0	0.0	--	--	--	--	--	0.0	21.4	0.0	<1
A60	5/10/1999	--	0.0	<40	--	--	0.0	0.0	--	--	--	--	--	0.0	20.3	0.0	<1
A60	5/28/1999	--	0.0	150.5	--	--	0.0	0.0	--	--	--	--	--	0.0	22.7	0.0	1.6
A60	6/10/1999	--	0.0	1685.0	--	--	0.0	0.0	--	--	--	--	--	0.0	16	0.0	<1
A60	7/15/1999	--	0.0	0.0	--	--	0.0	0.0	--	--	--	--	--	0.0	19	0.0	<1
A60	7/30/1999	--	<40	--	--	--	--	--	--	--	--	--	--	--	20.777	--	<1
A60	8/19/1999	--	--	72.5	--	--	--	--	--	--	--	--	--	--	23.540	--	<1
A61	9/9/1991	--	95.0	60.0	<.2	<.2	--	--	--	--	--	--	--	--	--	--	--
A61	6/25/1992	--	--	ND	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A61	10/15/1992	--	--	--	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A61	7/20/1993	--	--	ND	--	--	--	--	--	--	--	--	--	--	--	--	--
A61	10/23/1996	32.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A61	4/16/1997	26.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A61	9/8/1997	22.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A61	9/2/1998	--	138.0	51.0	ND	<.2	ND	1.3	--	--	--	ND	ND	27	25	ND	ND
A61	6/23/1999	--	757.0	ND	ND	<.2	1.7	<1	--	--	--	ND	ND	22.5	15.3	ND	ND
A62	9/9/1991	--	ND	ND	<.2	<.2	ND	--	--	--	--	--	--	--	--	--	--
A62	6/25/1992	--	--	ND	--	<.2	ND	--	--	--	--	--	--	--	--	--	--
A62	10/15/1992	--	--	ND	--	<.2	--	<1	--	--	--	--	--	--	--	--	--
A62	7/20/1993	--	--	ND	--	--	--	--	--	--	--	--	--	--	--	--	--
A62	10/23/1996	30.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Alkalinity	Total Aluminum	Dissolved Aluminum	Total Silver	Dissolved Silver	Total Silver	Dissolved Arsenic	Total Boron	Dissolved Boron	Dissolved Bromine	Total Antimony	Dissolved Antimony	Total Barium	Dissolved Barium	Total Beryllium	Dissolved Beryllium
		mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	--	--	--	--	--	340	--	--	--	--	--	--	--	--	--
A62	4/18/1997	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A62	9/8/1997	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A62	9/2/1998	--	40.0	ND	ND	<.2	ND	<1	--	--	--	ND	ND	9	9	ND	ND
A62	6/23/1999	--	124.0	ND	0.2	<.2	ND	<1	--	--	--	ND	ND	6.7	6.1	ND	ND
A63	9/9/1991	--	ND	ND	<.2	<.2	--	--	--	--	--	--	--	--	--	--	--
A63	10/15/1992	--	--	ND	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A63	7/20/1993	--	--	ND	--	--	--	--	--	--	--	--	--	--	--	--	--
A64	9/9/1991	--	65.0	ND	<.2	<.2	ND	--	--	--	--	--	--	--	--	--	--
A64	6/25/1992	--	--	51.0	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A64	10/15/1992	--	--	--	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A64	7/20/1993	--	--	ND	--	--	--	--	--	--	--	--	--	--	--	--	--
A64	9/8/1997	28.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A64	9/2/1998	--	114.0	47.0	ND	<.2	ND	<1	--	--	--	ND	ND	26	24	ND	ND
A64	6/24/1999	--	370.0	ND	ND	<.2	ND	<1	--	--	--	ND	ND	20.3	14.6	ND	ND
A65	9/9/1991	--	94.0	52.0	<.2	<.2	--	--	--	--	--	--	--	--	--	--	--
A65	6/25/1992	--	--	ND	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A65	10/15/1992	--	--	ND	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A65	7/20/1993	--	--	ND	--	--	--	--	--	--	--	--	--	--	--	--	--
A66	9/9/1991	--	86.0	ND	<.2	<.2	--	--	--	--	--	--	--	--	--	--	--
A66	6/25/1992	--	--	ND	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A66	10/15/1992	--	--	--	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A66	7/20/1993	--	--	ND	--	--	--	--	--	--	--	--	--	--	--	--	--
A66	9/2/1998	--	162.0	62.0	ND	<.2	1.5	<1	--	--	--	ND	ND	26	24	ND	ND
A66	6/23/1999	--	416.0	40.0	ND	<.2	ND	<1	--	--	--	ND	ND	20.5	14.4	ND	ND
A67	9/9/1991	--	ND	ND	<.2	<.2	--	--	--	--	--	--	--	--	--	--	--
A67	6/25/1992	--	--	ND	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A67	10/15/1992	--	--	ND	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A67	6/15/2007	19.9	178	<100	--	--	<4	<4	--	--	--	--	--	--	--	--	--
A68	9/5/1991	--	79.0	56.0	<.2	<.2	--	--	--	--	--	--	--	--	--	--	--
A68	9/6/1991	--	270.0	95.0	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A68	9/7/1991	--	310.0	83.0	0.4	<.2	--	--	--	--	--	--	--	--	--	--	--
A68	9/9/1991	--	110.0	72.0	<.2	<.2	--	--	--	--	--	--	--	--	--	--	--
A68	9/10/1991	--	180.0	93.0	<.2	<.2	--	--	--	--	--	--	--	--	--	--	--
A68	12/8/1991	32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	1/15/1992	56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	2/13/1992	32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	3/5/1992	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	3/16/1992	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/13/1992	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/20/1992	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/30/1992	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/5/1992	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/11/1992	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/18/1992	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/26/1992	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Alkalinity	Total Aluminum	Dissolved Aluminum	Total Silver	Dissolved Silver	Total Silver	Dissolved Arsenic	Total Boron	Dissolved Boron	Dissolved Bromine	Total Antimony	Dissolved Antimony	Total Barium	Dissolved Barium	Total Beryllium	Dissolved Beryllium
		mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	--	--	--	--	--	340	--	--	--	--	--	--	--	--	--
A68	6/1/1992	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/8/1992	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/15/1992	46	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/22/1992	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/23/1992	24	--	ND	--	<.05	--	--	--	--	--	--	--	--	--	--	--
A68	6/24/1992	--	--	60.0	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A68	6/25/1992	--	--	50.0	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A68	7/14/1992	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/21/1992	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/27/1992	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	8/10/1992	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	8/24/1992	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	9/15/1992	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	9/16/1992	32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	10/14/1992	32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	10/14/1992	--	--	ND	--	<.2	--	--	--	--	--	--	--	--	--	--	--
A68	10/15/1992	--	--	ND	--	<.2	--	<1	--	--	--	--	--	--	--	--	--
A68	11/18/1992	34	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	12/16/1992	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	1/13/1993	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	2/17/1993	54	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	3/10/1993	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	3/31/1993	26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/14/1993	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/21/1993	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/29/1993	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/4/1993	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/12/1993	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/26/1993	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/2/1993	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/9/1993	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/16/1993	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/23/1993	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/14/1993	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/20/1993	--	--	ND	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/21/1993	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/21/1993	--	--	ND	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/28/1993	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	8/11/1993	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	8/25/1993	42	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	9/15/1993	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	10/13/1993	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	11/17/1993	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	12/15/1993	26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	1/12/1994	38	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	3/16/1994	26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	3/30/1994	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/13/1994	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/20/1994	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/27/1994	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/3/1994	26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Alkalinity	Total Aluminum	Dissolved Aluminum	Total Silver	Dissolved Silver	Total Silver	Dissolved Arsenic	Total Boron	Dissolved Boron	Dissolved Bromine	Total Antimony	Dissolved Antimony	Total Barium	Dissolved Barium	Total Beryllium	Dissolved Beryllium
		mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	--	--	--	--	--	340	--	--	--	--	--	--	--	--	--
A68	5/11/1994	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/18/1994	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/24/1994	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/1/1994	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/8/1994	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/15/1994	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/22/1994	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/13/1994	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/20/1994	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/27/1994	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	8/10/1994	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	8/24/1994	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	9/15/1994	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	10/13/1994	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	11/9/1994	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	11/9/1994	0	77.0	ND	<.2	<.2	ND	<.5	--	--	0	--	--	--	--	--	--
A68	12/13/1994	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	1/18/1995	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	2/15/1995	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	3/1/1995	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	3/15/1995	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/6/1995	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/12/1995	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/12/1995	--	230.0	ND	<.2	<.2	ND	<.5	--	--	--	5	5	20	21	146	0.65
A68	4/19/1995	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/3/1995	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/10/1995	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/22/1995	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/31/1995	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/7/1995	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/14/1995	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/21/1995	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/21/1995	24	129.0	88.0	<.2	<.2	ND	<.5	--	--	--	3	3	7	6	54	2
A68	6/28/1995	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/5/1995	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/12/1995	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/19/1995	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	8/2/1995	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	8/16/1995	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	9/6/1995	32	200.0	24.0	<.2	<.2	ND	<.5	--	--	--	3	ND	24	27	ND	ND
A68	9/13/1995	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	10/11/1995	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	11/15/1995	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	11/29/1995	36	230.0	185.0	<.2	<.2	ND	<.5	--	--	--	--	--	26	--	ND	--
A68	12/13/1995	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	2/14/1996	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	3/13/1996	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	3/20/1996	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/3/1996	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/9/1996	28	300.0	ND	<5	<5	ND	<5	--	--	--	ND	ND	ND	ND	ND	ND
A68	4/10/1996	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Alkalinity	Total Aluminum	Dissolved Aluminum	Total Silver	Dissolved Silver	Total Silver	Dissolved Arsenic	Total Boron	Dissolved Boron	Dissolved Bromine	Total Antimony	Dissolved Antimony	Total Barium	Dissolved Barium	Total Beryllium	Dissolved Beryllium
		mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	--	--	--	--	--	340	--	--	--	--	--	--	--	--	--
A68	4/17/1996	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/1/1996	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/8/1996	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/15/1996	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/21/1996	18	500.0	ND	<5	<5	ND	<5	--	--	--	ND	ND	ND	ND	ND	ND
A68	5/29/1996	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/5/1996	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/12/1996	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/19/1996	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/26/1996	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/3/1996	26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/10/1996	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/16/1996	26	ND	ND	<5	<5	ND	<5	--	--	--	ND	ND	ND	ND	ND	ND
A68	7/17/1996	48	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	8/7/1996	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	8/14/1996	34.0	ND	ND	<5	<5	ND	<5	--	--	--	ND	ND	ND	ND	ND	ND
A68	8/21/1996	32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	9/18/1996	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	10/1/1996	--	69.0	0.0	--	--	0	0	--	--	--	0	0	24.9	22.4	0	0
A68	10/1/1996	--	69.0	0.0	--	--	0	0	--	--	--	0	0	24.9	22.4	0	0
A68	10/16/1996	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	10/23/1996	30.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	11/13/1996	26.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	11/19/1996	--	140.5	78.5	--	--	0.0	0.0	--	--	--	--	--	25.5	26.3	<1	<1
A68	1/7/1997	38.0	200.0	<100	<5	<5	<5	<5	--	--	<50	<50	<50	<50	<4	<4	<4
A68	1/8/1997	--	197.0	88.6	--	--	0.0	0.0	--	--	--	--	--	26.2	21.8	<1	<1
A68	1/30/1997	--	213.3	79.0	--	--	0.0	0.0	--	--	--	--	--	29.4	25.6	<1	<1
A68	2/25/1997	--	162.2	118.7	--	--	0.0	0.0	--	--	--	--	--	23.1	21.0	<1	<1
A68	3/5/1997	36.0	200.0	ND	<5	<5	ND	<5	--	--	--	ND	ND	ND	ND	ND	ND
A68	3/12/1997	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	3/19/1997	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	3/25/1997	--	339.2	114.8	--	--	0.0	0.0	--	--	--	--	--	22.6	18.6	<1	<1
A68	4/2/1997	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/16/1997	26.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/16/1997	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/29/1997	--	219.5	133.2	--	--	0.0	0.0	--	--	--	--	--	21.3	20.9	<1	<1
A68	4/30/1997	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/7/1997	28	300.0	ND	<5	<5	ND	<5	--	--	--	ND	ND	ND	ND	ND	ND
A68	5/14/1997	20.7	554.9	134.8	--	--	0.0	0.0	--	--	--	--	--	24.5	17.5	<1	<1
A68	5/21/1997	20.0	130.4	113.7	--	--	0.0	0.0	--	--	--	--	--	16.7	17.2	<1	<1
A68	5/21/1997	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/28/1997	32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/29/1997	23.0	94.8	106.8	--	--	0.0	0.0	--	--	--	--	--	17.9	18.5	<1	<1
A68	6/4/1997	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/5/1997	--	472.6	91.5	--	--	0.0	0.0	--	--	--	--	--	20.6	13.8	<1	<1
A68	6/11/1997	--	104.8	<40	--	--	0.0	0.0	--	--	--	--	--	16.0	16.5	<1	<1
A68	6/11/1997	18.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/16/1997	--	67.3	60.3	--	--	0.0	0.0	--	--	--	--	--	16.4	17.7	<1	<1
A68	6/18/1997	20.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/25/1997	14.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/26/1997	--	51.5	<40	--	--	0.0	0.0	--	--	--	--	--	17.2	14.6	<1	<1

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Alkalinity	Total Aluminum	Dissolved Aluminum	Total Silver	Dissolved Silver	Total Silver	Dissolved Arsenic	Total Boron	Dissolved Boron	Dissolved Bromine	Total Antimony	Dissolved Antimony	Total Barium	Dissolved Barium	Total Beryllium	Dissolved Beryllium
		mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	--	--	--	--	340	--	--	--	--	--	--	--	--	--	--
A68	7/1/1997	--	<40	<40	--	--	0.0	0.0	--	--	--	--	14.9	15.8	<1	<1	
A68	7/2/1997	12.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	7/9/1997	22	100.0	ND	<.1	<.1	ND	<5	--	--	--	ND	ND	ND	ND	ND	
A68	7/15/1997	--	<40	<40	--	--	0.0	0.0	--	--	--	--	16.3	15.9	<1	<1	
A68	7/16/1997	16.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	7/30/1997	--	44.8	48.2	--	--	0.0	0.0	--	--	--	--	15.3	19.4	<1	<1	
A68	8/12/1997	--	<40	<40	--	--	0.0	0.0	--	--	--	--	20.4	22.8	<1	<1	
A68	8/13/1997	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	
A68	8/13/1997	8.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	9/11/1997	34.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	9/11/1997	32	ND	ND	<.1	<.1	ND	<5	--	--	--	ND	ND	ND	ND	ND	
A68	9/17/1997	60.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	9/25/1997	--	124.3	90.2	--	--	0.0	0.0	--	--	--	--	24.8	23.4	<1	<1	
A68	10/8/1997	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	
A68	10/15/1997	4.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	10/22/1997	--	<40	<40	--	--	0.0	0.0	--	--	--	--	5.8	23.1	<1	2.2	
A68	11/12/1997	4.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	11/12/1997	34	100.0	ND	<.1	<.1	ND	<5	--	--	--	ND	ND	ND	ND	ND	
A68	11/25/1997	--	<40	<40	--	--	0.0	0.0	--	--	--	--	5.8	24.0	<1	<1	
A68	12/3/1997	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	
A68	12/17/1997	6.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	12/23/1997	--	114.4	<40	--	--	0.0	0.0	--	--	--	--	23.3	25.0	<1	<1	
A68	1/7/1998	48	ND	ND	<.1	<.1	ND	<5	--	--	--	ND	ND	ND	ND	ND	
A68	2/4/1998	--	--	50.0	--	--	--	--	--	--	--	--	--	--	--	--	
A68	2/12/1998	--	147.8	<40	--	--	0.0	0.0	--	--	--	--	24.2	25.0	<1	<1	
A68	3/4/1998	4.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	3/5/1998	44	ND	ND	<.1	<.1	ND	<5	--	--	--	ND	ND	ND	ND	ND	
A68	3/16/1998	--	145.3	65.7	--	--	0.0	0.0	--	--	--	--	23.4	21.9	<1	1.2	
A68	3/18/1998	10.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	4/1/1998	2.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	4/8/1998	--	--	120.0	--	--	--	--	--	--	--	--	--	--	--	--	
A68	4/15/1998	18.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	4/23/1998	--	374.3	168.9	--	--	0.0	0.0	--	--	--	--	25.2	21.5	<1	1.6	
A68	4/29/1998	20.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	5/5/1998	16.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	5/6/1998	--	163.6	117.7	--	--	0.0	0.0	--	--	--	--	20.1	19.5	<1	<1	
A68	5/7/1998	28	180.0	ND	<5	<5	ND	<5	--	--	--	ND	ND	ND	ND	ND	
A68	5/13/1998	18.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	5/20/1998	14.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	5/27/1998	18.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	5/29/1998	--	344.8	73.9	--	--	0.0	0.0	--	--	--	--	20.8	15.2	<1	<1	
A68	6/2/1998	--	538.8	67.3	--	--	0.0	0.0	--	--	--	--	22.4	14.2	<1	<1	
A68	6/3/1998	14.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	6/9/1998	--	108.3	79.8	--	--	0.0	0.0	--	--	--	--	17.0	16.2	<1	<1	
A68	6/10/1998	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	6/10/1998	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	
A68	6/17/1998	24.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	6/17/1998	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	6/24/1998	--	137.5	64.2	--	--	0.0	0.0	--	--	--	--	18.1	13.6	<1	<1	
A68	6/24/1998	14.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	7/1/1998	20.00	180.0	ND	<.1	<.1	ND	<5	--	--	--	ND	ND	ND	ND	ND	

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Alkalinity	Total Aluminum	Dissolved Aluminum	Total Silver	Dissolved Silver	Total Silver	Dissolved Arsenic	Total Boron	Dissolved Boron	Dissolved Bromine	Total Antimony	Dissolved Antimony	Total Barium	Dissolved Barium	Total Beryllium	Dissolved Beryllium
		mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	--	--	--	--	--	<b>340</b>	--	--	--	--	--	--	--	--	--
A68	7/9/1998	--	107.9	68.1	--	--	0.0	0.0	--	--	--	--	--	18.5	15.7	1.2	<1
A68	7/15/1998	22.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/22/1998	--	95.4	44.4	--	--	0.0	0.0	--	--	--	--	--	19.8	19.2	<1	<1
A68	7/22/1998	14.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	8/5/1998	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	8/26/1998	2.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	9/2/1998	--	160.0	ND	ND	<.2	1	<1	--	--	--	ND	ND	25	24	ND	ND
A68	9/2/1998	--	160.0	ND	ND	<.2	1	<1	--	--	--	ND	ND	25	24	ND	ND
A68	9/9/1998	34.00	ND	ND	<.1	<.1	ND	<5	--	--	--	ND	ND	ND	ND	ND	ND
A68	9/16/1998	28.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	9/30/1998	--	127.1	79.8	--	--	0.0	0.0	--	--	--	--	--	26.5	25.7	<1	<1
A68	10/7/1998	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	11/3/1998	36	ND	ND	<5	<5	ND	<5	--	--	--	ND	ND	ND	ND	ND	ND
A68	11/18/1998	34.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	12/2/1998	--	--	120.0	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	1/6/1999	34.00	130.0	0.1	<5	<5	ND	<5	--	--	--	ND	ND	ND	ND	ND	ND
A68	1/6/1999	34	130.0	70.0	<5	<5	ND	<5	--	--	--	ND	ND	ND	ND	ND	ND
A68	2/4/1999	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	2/17/1999	--	0.0	<40	--	--	0.0	0.0	--	--	--	--	--	0.0	24.5	0.0	1.4
A68	2/24/1999	2.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	3/3/1999	34.00	140.0	ND	<5	<5	ND	<5	--	--	--	ND	ND	ND	ND	ND	ND
A68	3/17/1999	12.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/1/1999	18.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/7/1999	--	--	80.0	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/26/1999	22.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	4/29/1999	--	0.0	<40	--	--	0.0	0.0	--	--	--	--	--	0.0	21.0	0.0	1.2
A68	5/6/1999	28.00	390.0	ND	<5	<5	ND	<5	--	--	--	ND	ND	ND	ND	ND	ND
A68	6/9/1999	--	--	70.0	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/23/1999	--	437.0	ND	ND	<.2	ND	<1	--	--	--	ND	ND	21.6	15	ND	ND
A68	6/23/1999	--	437.0	ND	ND	<.2	ND	<1	--	--	--	ND	ND	21.6	15	ND	ND
A68	7/7/1999	--	--	50.0	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	8/4/1999	30	180.0	<100	<.1	<.1	<5	<5	--	--	--	<50	<50	<50	<50	<4	<4
A68	8/4/1999	30	180.0	<100	<.1	<.1	<5	<5	--	--	--	<50	<50	<50	<50	<4	<4
A68	8/19/1999	--	--	85.1	--	--	--	--	--	--	--	--	--	--	22.898	--	<1
A68	9/1/1999	38	100.0	<100	<.1	<.1	<5	<5	--	--	--	<5	<5	25	25	<1	<1
A68	9/16/1999	8.0	172.0	62.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	10/6/1999	--	--	80.0	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	10/14/1999	24.0	418.0	209.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	11/3/1999	33	140.0	100.0	0.0001	<.1	<1	<1	--	--	--	2	<1	26	27	<1	<1
A68	11/17/1999	16.0	166.0	159.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	12/1/1999	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	1/5/2000	34	<100	<100	<.1	<.1	<1	<1	--	--	--	1	1	25	26	<1	<1
A68	2/2/2000	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	2/28/2000	10.0	194.0	65.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	3/1/2000	36	120.0	<100	<.2	<.2	<1	<1	--	--	--	2	2	27	25	<1	<1
A68	3/15/2000	24.0	138.0	79.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	4/5/2000	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/3/2000	30	260.0	57.0	<1	<1	<10	<10	--	--	--	<5	<5	<50	<50	<1	<1
A68	6/7/2000	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/5/2000	23	90.0	51.0	<1	<1	<10	<10	--	--	--	<5	<5	21	2	<1	<1
A68	8/2/2000	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	--

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Alkalinity	Total Aluminum	Dissolved Aluminum	Total Silver	Dissolved Silver	Total Silver	Dissolved Arsenic	Total Boron	Dissolved Boron	Dissolved Bromine	Total Antimony	Dissolved Antimony	Total Barium	Dissolved Barium	Total Beryllium	Dissolved Beryllium
		mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	--	--	--	--	340	--	--	--	--	--	--	--	--	--	--
A68	9/6/2000	28	210.0	<45	<1	<1	<1	<1	--	--	<5	<5	27	23	<4	<4	
A68	10/4/2000	--	--	60.0	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	11/1/2000	22	190.0	<45	<.1	<.1	<1	<1	--	--	<5	<5	22	22	<4	<4	
A68	12/6/2000	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	1/3/2001	50	<45	<.062	0.1	<.1	<1	<1	--	--	<5	<5	27	26	<4	<4	
A68	2/7/2001	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	3/14/2001	32	<20	<45	<.1	<.1	<1	<1	--	--	<5	<5	24	25	<1	<1	
A68	4/4/2001	--	--	110.0	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/2/2001	32	600.0	<230	0.1	<.1	2	<1	--	--	<5	<5	23	18	<1	<1	
A68	6/6/2001	--	--	50.0	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	7/6/2001	27	<500	<100	<.1	<.1	<5	<5	--	--	<5	<5	18	18	<1	<1	
A68	8/1/2001	--	--	90.0	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	10/3/2001	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	12/5/2001	--	--	50.0	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	1/2/2002	37	<500	<100	<.1	<.1	<5	<5	--	--	<3	<3	0.027	0.027	<.5	<.5	
A68	3/6/2002	<5	<100	<100	<.1	<.1	<1	<1	--	--	<3	--	26	27	<.5	<.5	
A68	4/3/2002	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	5/1/2002	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	6/5/2002	25	23.0	<3	<.2	<.2	<1	<1	--	--	--	--	--	--	--	--	--
A68	6/27/2002	28.0	81.0	43.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	7/3/2002	33	<100	<100	<.9	<.1	<1	<1	--	--	--	--	--	--	--	--	--
A68	7/17/2002	22.0	136.0	66.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	8/7/2002	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	8/14/2002	34.0	80.0	60.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	9/4/2002	36	70.0	41.0	<1	<1	<1	<1	--	--	<1	<1	29	29	<1	<1	
A68	9/18/2002	26.0	86.0	48.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	10/2/2002	--	--	70.0	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	10/25/2002	30.0	77.0	59.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	11/6/2002	37	101.0	60.0	<1	<1	<1	<1	--	--	<1	<1	25	26	<1	<1	
A68	11/12/2002	30.0	121.0	78.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	12/4/2002	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	12/8/2002	30.0	147.0	33.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	1/8/2003	32.0	157.0	70.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	1/9/2003	35	108.0	40.0	<1	<1	<1	<1	--	--	<1	<1	27	30	<1	<1	
A68	2/1/2003	32.0	124.0	53.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	2/5/2003	--	--	<50	--	--	--	--	--	--	--	--	--	--	--	--	--
A68	3/9/2003	28.0	164.0	47.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	4/24/2003	28.0	181.0	104.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	5/7/2003	24.0	104.0	45.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	5/7/2003	27	140.5	19.9	<0.2	0.6	<1	<1	--	--	<1	<1	20.33	20.97	<1	<1	
A68	6/2/2003	16	328	0	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	7/2/2003	22.0	80.0	0.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	7/2/2003	26	59.0	26.3	0.25	<0.2	<1	<1	--	--	<1	<1	21.83	19.4	<1	<1	
A68	8/14/2003	24.0	569.0	54.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	9/11/2003	26.0	289.0	63.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	9/11/2003	30	309.0	--	--	--	<1	--	--	--	<1	--	24	--	<1	--	--
A68	10/4/2003	30.0	133.0	85.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	11/6/2003	38	150.0	58.0	0.6	<.2	<1	<1	--	--	<1	<1	32	29	<1	<1	
A68	12/29/2003	32.0	147.0	29.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	3/3/2004	34.0	128.0	36.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	3/3/2004	33.4	127.0	45.0	<.2	<.2	<1	<1	--	--	<1	<1	25	26	<1	<1	

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Alkalinity	Total Aluminum	Dissolved Aluminum	Total Silver	Dissolved Silver	Total Silver	Dissolved Arsenic	Total Boron	Dissolved Boron	Dissolved Bromine	Total Antimony	Dissolved Antimony	Total Barium	Dissolved Barium	Total Beryllium	Dissolved Beryllium
		mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	--	--	--	--	--	<b>340</b>	--	--	--	--	--	--	--	--	--
A68	4/16/2004	22.0	404.0	117.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	5/5/2004	24.0	383.0	93.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	5/5/2004	26.4	381.0	76.0	<.2	<.2	<1	<1	--	--	--	<1	<1	23	19	<1	<1
A68	5/28/2004	22.0	348.0	46.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	6/17/2004	20.0	170.0	52.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	7/7/2004	25	102.0	34.0	<.2	<.2	<1	<1	--	--	--	<1	<1	20	18	<1	<1
A68	7/7/2004	22	120	60	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	8/19/2004	32.0	159.0	<15	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	9/1/2004	34	134.0	87.0	<.2	<1	<1	<2	--	--	--	<1	<1	28	25	<1	<1
A68	9/15/2004	28	132	79	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	10/14/2004	22.0	120.0	60.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	11/10/2004	--	119.0	52.0	0.2	0.2	1	1	--	--	--	1	1	23	23	1	1
A68	11/10/2004	30	115.0	49.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	12/8/2004	28	117.0	70.0	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	1/20/2005	32	123.1	109.2	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	2/15/2005	30	278.2	107.5	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	03/02/2005	--	220	34	<.2	<.2	<1	<1	--	--	--	<1	<1	27	25	<1	<1
A68	3/13/2005	30	298.6	119.1	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	4/9/2005	28	356.4	114.8	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	5/4/2005	26	283.7	48.8	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	05/04/2005	--	306	66	<1	<.2	<1	<1	--	--	--	<1	<1	22	24	<1	<1
A68	6/9/2005	16	252	48	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	7/6/2005	18	133	55	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	07/06/2005	--	144	43	<.2	<.2	<1	<1	--	--	--	<1	<1	19	18	<1	<1
A68	8/10/2005	26	108	67	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	9/14/2005	38	95	58	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	9/15/2005	--	110	58	<1	<1	<1	<1	--	--	--	<1	<1	25	25	<1	<1
A68	10/13/2005	28	184	128	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	11/2/2005	28	113	83	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	11/2/2005	--	126	63	<1	<1	<1	<1	--	--	--	<1	<1	25	24	<1	<1
A68	12/20/2005	30	135	114	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	1/6/2006	28	131	58	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	01/06/2006	--	137	65	0.5	0.3	<1	<1	--	--	--	<1	<1	27	25	<1	<1
A68	2/8/2006	24	213	138	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	3/15/2006	20	162	119	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	03/15/2006	--	173	76	<0.2	<0.2	<1	<1	--	--	--	<1	<1	24	24	<1	<1
A68	4/5/2006	30	317	100	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	5/10/2006	16	145	96	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	05/10/2006	--	160	71	<0.2	<0.2	<1	<1	--	--	--	<1	<1	18	19	<1	<1
A68	05/16/2006	--	--	46	--	<0.2	--	<1	--	--	--	--	<1	--	17	--	<1
A68	6/6/2006	12	272	63	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	7/12/2006	26	142	68	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	07/12/2006	--	141	44	0.3	<0.2	<1	<1	--	--	--	<1	<1	21	21	<1	<1
A68	8/2/2006	28	161	63	--	--	<15	15	--	--	--	--	--	--	--	--	--
A68	9/6/2006	34	27	48	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	09/06/2006	--	109	46	<0.2	<0.2	<1	<1	--	--	--	<1	<1	24	24	<1	<1
A68	10/11/2006	24	194	59	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	11/1/2006	30	133	57	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	11/01/2006	--	166	65	<0.2	<0.2	<1	<1	--	--	--	<1	<1	25	25	<1	<1
A68	12/5/2006	30	119	75	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	1/11/2007	32	130	89	--	--	<15	<15	--	--	--	--	--	--	--	--	--

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Alkalinity	Total Aluminum	Dissolved Aluminum	Total Silver	Dissolved Silver	Total Silver	Dissolved Arsenic	Total Boron	Dissolved Boron	Dissolved Bromine	Total Antimony	Dissolved Antimony	Total Barium	Dissolved Barium	Total Beryllium	Dissolved Beryllium
		mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	--	--	--	--	340	--	--	--	--	--	--	--	--	--	--
A68	2/6/2007	32	170	109	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	3/7/2007	28	126	49	--	--	<15	16	--	--	--	--	--	--	--	--	--
A68	03/07/2007	--	137	66	<.2	<.2	<1	<1	--	--	--	<1	<1	25	25	<1	<1
A68	4/2/2007	28	200	75	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	05/11/2007	--	246	79	<.2	<.2	<1	<1	--	--	--	<1	<1	21	21	<1	<1
A68	5/11/2007	16	202	63	--	--	103	55	--	--	--	--	--	--	--	--	--
A68	6/5/2007	12	339	39.5	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	6/14/2007	23.8	160	<100	--	--	<4	<4	--	--	--	--	--	--	--	--	--
A68	6/14/2007	23.8	160	<100	--	--	<4	<4	--	--	--	--	--	--	--	--	--
A68	7/11/2007	14	131	48	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	07/11/2007	--	105	42	<.2	<.2	<1	<1	--	--	--	<1	<1	21	19	<1	<1
A68	8/6/2007	14	650	58	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	9/5/2007	10	141	54	--	--	64	57	--	--	--	--	--	--	--	--	--
A68	09/05/2007	--	100	100	<10	<10	<1	<1	--	--	<50	<50	<100	<.1	<10	<10	<10
A68	10/25/2007	30	152	75	--	--	41	54	--	--	--	--	--	--	--	--	--
A68	11/07/2007	--	108	51	<.2	<.2	<1	<1	--	--	<1	<1	25	26	<1	<1	<1
A68	12/5/2007	1	132	79	--	--	218	274	--	--	--	--	--	--	--	--	--
A68	1/2/2008	--	97.0	49.0	<.2	<.2	<1	<1	--	--	<1	<1	26	25	<1	<1	<1
A68	1/2/2008	--	20	40	--	--	100	69	--	--	--	--	--	--	--	--	--
A68	3/12/2008	--	273.0	68.0	<.4	0.8	1	<1	--	--	<1	<1	26	26	<1	<1	<1
A68	4/10/2008	--	530	134	--	--	253	51	--	--	--	--	--	--	--	--	--
A68	5/7/2008	26	260	99	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	5/7/2008	--	301.0	47.0	<.2	<.2	<1	<1	--	--	<1	<1	25	21	<1	<1	<1
A68	6/3/2008	18	1119	34	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	7/9/2008	20	126	43	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	7/9/2008	--	146.0	33.0	<.2	<.2	3	<1	--	--	<2	<1	17	17	<1	<1	<1
A68	8/5/2008	24	116	61	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	9/3/2008	30	100	72	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	9/3/2008	--	102	48	<.2	<.2	<1	<2	--	--	<1	<1	24	24	<1	<1	<1
A68	10/6/2008	30	119	81	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	11/7/2008	30	80	25	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	11/7/2008	--	138.0	55.0	<.2	<.2	<1	<1	--	--	<1	<1	27	27	<1	<1	<1
A68	12/3/2008	28	128	73	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	3/4/2009	28	225	65	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	3/4/2009	--	243	88	<.2	<.2	<1	<1	--	--	<1	<1	23	25	<1	<1	<1
A68	4/6/2009	24	341	87	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	5/13/2009	--	1630	23	<.2	<.2	3	<1	--	--	<1	<1	36	13	<1	<1	<1
A68	5/13/2009	18	1455	32	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	5/19/2009	--	1010	<100	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	<1	<1	<1.00	<1.00
A68	6/2/2009	16	145	37	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	6/16/2009	--	165	<100	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	<1.0	<1.0	<1.0	<1.0
A68	7/8/2009	20	96	37	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	7/8/2009	20	--	96	37	--	--	<15	--	--	--	--	--	--	--	--	--
A68	7/8/2009	--	75	43	<.2	<.2	<1	<1	--	--	<1	<1	20	19	<1	<1	<1
A68	7/14/2009	--	117	<100	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	<1	<1	<1.00	<1.00
A68	8/12/2009	20	68	50	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	8/18/2009	--	120	<100	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	<1.0	<1.0	<1.0	<1.0
A68	9/16/2009	30	87	37	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	9/16/2009	--	181	58	<.2	<.2	<1	<1	--	--	<1	<1	25	24	<1	<1	<1
A68	9/22/2009	--	134	<100	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	<1.0	<1.0	<1.0	<1.0
A68	10/5/2009	30	124	78	--	--	0	0	--	--	--	--	--	--	--	--	--

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Alkalinity	Total Aluminum	Dissolved Aluminum	Total Silver	Dissolved Silver	Total Silver	Dissolved Arsenic	Total Boron	Dissolved Boron	Dissolved Bromine	Total Antimony	Dissolved Antimony	Total Barium	Dissolved Barium	Total Beryllium	Dissolved Beryllium
		mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	--	--	--	--	<b>340</b>	--	--	--	--	--	--	--	--	--	--
A68	11/4/2009	--	120.0	109.0	<.2	<.2	<1	<1	--	--	--	<1	<1	25	24	<1	<1
A68	11/5/2009	30	181	20	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	11/17/2009	--	189	103	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	--	<1.0	<1.0	
A68	12/1/2009	28	140	68	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	2/17/2010	--	269	141	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	--	<1.0	<1.0	
A68	3/2/2010	30	196	122	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	3/17/2010	--	177	<100	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	--	<1.0	<1.0	
A68	4/16/2010	30	317	210	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	5/5/2010	24	159	85	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	5/5/2010	--	140.0	65.0	<.2	<.2	<1	<1	--	--	--	<1	<1	19	19	<1	<1
A68	6/2/2010	20	353	36	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	6/2/2010	--	348	<100	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	--	<1.0	<1.0	
A68	7/8/2010	20	73	42	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	7/8/2010	--	60.0	37.0	<.2	<.2	<1	<1	--	--	--	<1	<1	19	20	<1	<1
A68	7/13/2010	--	<100	<100	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	--	<1.0	<1.0	
A68	8/10/2010	28	158	67	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	9/9/2010	34	88	44	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	9/9/2010	--	90.0	35.0	<.2	<.2	<1	<1	--	--	--	1	<1	26	25	<1	<1
A68	9/14/2010	--	124	<100	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	--	<1.0	<1.0	
A68	10/4/2010	34	78	55	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	11/2/2010	--	101	<100	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	--	<1.0	<1.0	
A68	11/3/2010	--	80.0	46.0	<.2	<.2	<1	<1	--	--	--	<1	<1	26	26	<1	<1
A68	11/3/2010	36	79	44	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	12/7/2010	32	115	86	--	--	0	0	--	--	--	--	--	--	--	--	--
A68	1/5/2011	32	75	33	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	1/5/2011	--	9.0	25.0	<.2	<.2	<1	<1	--	--	--	<1	<1	26	26	<1	<1
A68	2/11/2011	34	176	67	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	3/9/2011	36	93	36	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	3/9/2011	--	280	59	<.2	<.2	<1	<1	--	--	--	<1	<1	26	25	<1	<1
A68	3/15/2011	--	275	<100	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	--	<1.0	<1.0	
A68	4/6/2011	32	454	103	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	5/4/2011	--	308	70	<.2	<.2	<1	<1	--	--	--	<1	<1	22	24	<1	<1
A68	5/8/2011	26	447	96	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	6/3/2011	22	299	35	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	6/14/2011	--	540	<100	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	--	<1.0	<1.0	
A68	7/5/2011	20	140	37	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	7/19/2011	--	217	<100	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	--	<1.0	<1.0	
A68	8/1/2011	26	76	39	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	8/16/2011	--	<100	<100	0.5	<0.5	<4.0	<4.0	--	--	--	--	--	--	<1.0	<1.0	
A68	9/7/2011	34	52	30	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	9/7/2011	--	72	37	<.2	<.2	<1	<1	--	--	--	<1	<1	26	24	<1	<1
A68	9/13/2011	--	<100	<100	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	--	<1.0	<1.0	
A68	10/7/2011	34	107	56	--	--	<15	<15	--	--	--	--	--	--	--	--	--
A68	10/18/2011	--	<100	<100	<0.5	<0.5	<4.0	<4.0	--	--	--	--	--	--	<1.0	<1.0	
A68	11/2/2011	16	96	48	<.2	<.2	<1	<1	--	--	--	<1	<1	24	25	<1	<1
A68	11/2/2011	--	96	48	<.2	<.2	<1	<1	--	--	--	<1	<1	24	25	<1	<1
A68	12/7/2011	34	161	52	--	--	<15	<15	--	--	--	--	--	--	--	--	--

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Cobalt	Dissolved Cobalt	Total Cadmium	Dissolved Cadmium	Total Copper	Dissolved Copper	Total Chromium	Dissolved Chromium	Total Iron	Dissolved Iron	Total Mercury	Dissolved Mercury	Total Lithium	Dissolved Lithium	Total Manganese	Dissolved Manganese	Total Nickel	Dissolved Nickel
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>	--	--	--	<b>2.2</b>	--	<b>2.7</b>	--	<b>24</b>	--	<b>1,000</b>	--	--	--	--	--	<b>2,179</b>	--	<b>16</b>	
A56	9/9/1991	--	--	0.90	0.80	4.00	<4	ND	ND	79.00	32.00	--	--	--	--	210.00	210.00	ND	ND
A56	6/25/1992	--	--	1.90	1.80	8.00	<b>8.00</b>	--	--	80.00	--	--	--	--	--	--	--	--	--
A56	10/15/1992	--	--	0.70	0.69	4.00	<b>5.00</b>	--	--	68.00	--	--	--	--	--	--	170.00	--	--
A56	9/2/1998	ND	7	0.70	<.6	6.00	<5	ND	ND	114.00	24.00	--	--	--	--	258.00	240.00	ND	ND
A56	6/24/1999	ND	ND	0.60	<.6	12.50	<b>6.10</b>	ND	ND	686.30	11.00	--	--	--	--	326.10	181.60	ND	ND
A58	9/9/1991	--	--	0.90	0.90	5.00	<4	ND	ND	10.00	ND	--	--	--	--	ND	ND	ND	ND
A58	6/25/1992	--	--	1.10	1.10	8.00	<b>6.00</b>	--	--	14.00	--	--	--	--	--	--	--	--	--
A58	10/15/1992	--	--	1.30	1.40	6.00	<b>8.00</b>	--	--	ND	--	--	--	--	--	--	ND	--	--
A58	9/2/1998	ND	ND	0.80	0.90	10.00	<b>5.00</b>	ND	ND	104.00	ND	--	--	--	--	13.00	2.00	ND	ND
A58	6/22/1999	ND	ND	ND	<.6	9.40	<b>9.10</b>	ND	ND	48.30	ND	--	--	--	--	5.20	1.90	ND	ND
A58	7/28/2002	--	--	1.61	1.64	6.10	<b>5.90</b>	--	--	25.00	11.00	--	--	--	--	<10	<10	--	--
A58	9/3/2002	--	--	1.49	1.50	5.40	<b>4.90</b>	--	--	<10	<10	--	--	--	--	<10	<10	--	--
A58	6/12/2003	--	--	0.86	0.83	7.10	<b>7.20</b>	--	--	12.00	<10	--	--	--	--	<10	<10	--	--
A58	10/19/2003	--	--	1.47	1.42	5.50	<b>5.20</b>	--	--	15.00	<10	--	--	--	--	<10	<10	--	--
A58	6/10/2004	--	--	1.02	0.96	7.80	<b>6.80</b>	--	--	14.00	0.00	--	--	--	--	<10	<10	--	--
A58	6/19/2004	--	--	1.01	0.99	5.60	<b>6.70</b>	--	--	16.00	0.00	--	--	--	--	<10	<10	--	--
A58	8/10/2009	--	--	--	1	--	<5	--	--	37	<10	--	--	--	--	3	--	--	--
A58	10/26/2009	--	--	--	1.3	--	<5	--	--	<10	<10	--	--	--	--	<2	--	--	--
A58	4/13/2010	--	--	--	0.77	--	<5	--	--	28	17	--	--	--	--	3	--	--	--
A58	7/7/2010	--	--	--	1	--	<b>8</b>	--	--	<10	<10	--	--	--	--	<2	--	--	--
A60	9/9/1991	--	--	1.00	0.90	5.00	<4	ND	ND	78.00	30.00	--	--	--	--	190.00	180.00	ND	ND
A60	6/25/1992	--	--	1.70	1.90	10.00	<b>6.00</b>	--	--	79.00	--	--	--	--	--	--	--	--	--
A60	10/15/1992	--	--	0.74	0.75	9.00	<b>5.00</b>	--	--	71.00	--	--	--	--	--	--	130.00	--	--
A60	7/20/1993	--	--	--	0.90	--	<b>6.00</b>	--	--	--	31.00	--	--	--	--	--	--	--	--
A60	4/6/1999	--	--	0.00	<2	0.00	<4	0.00	<15	0.00	<30	--	--	0.0	10.6	0.00	174.29	0.00	<20
A60	4/27/1999	--	--	0.00	<2	0.00	<4	0.00	<15	0.00	<30	--	--	0.0	10.7	0.00	182.18	0.00	<20
A60	5/10/1999	--	--	0.00	<b>2.44</b>	0.00	<4	0.00	<15	0.00	<30	--	--	0.0	11.6	0.00	206.03	0.00	<20
A60	5/28/1999	--	--	0.00	<2	0.00	<b>15.26</b>	0.00	<b>27.30</b>	0.00	69.33	--	--	0.0	<6	0.00	163.91	0.00	<20
A60	6/10/1999	--	--	0.00	<2	0.00	<b>4.58</b>	0.00	0.00	<30	--	--	0.0	6.0	0.00	105.01	0.00	<20	
A60	7/15/1999	--	--	0.00	<2	0.00	<4	0.00	0.00	<30	--	--	0.0	<6	0.00	162.33	0.00	<b>21.00</b>	
A60	7/30/1999	--	--	--	<b>3.16</b>	--	<4	--	<15	--	<30	--	--	<6	--	214.48	--	<b>38.31</b>	
A60	8/19/1999	--	--	--	<2	--	<4	--	<15	--	<30	--	--	<6	--	243.30	--	<20	
A61	9/9/1991	--	--	0.90	0.90	5.00	<b>4.00</b>	ND	ND	89.00	33.00	--	--	--	--	210.00	200.00	ND	ND
A61	6/25/1992	--	--	--	1.80	--	<b>6.00</b>	--	--	--	--	--	--	--	--	--	--	--	
A61	10/15/1992	--	--	--	1.10	--	<b>5.00</b>	--	--	--	--	--	--	--	--	--	--	--	
A61	7/20/1993	--	--	--	0.93	--	<b>5.00</b>	--	--	--	29.00	--	--	--	--	--	--	--	--
A61	10/23/1996	--	--	1.30	1.35	4.70	1.40	--	--	110.00	115.00	--	--	--	--	560.00	554.00	--	--
A61	4/16/1997	--	--	2.99	<b>2.78</b>	--	<b>2.80</b>	--	--	281.00	0.00	--	--	--	--	972.00	923.00	--	--
A61	9/8/1997	--	--	0.87	0.88	4.00	0.90	--	--	138.00	0.00	--	--	--	--	410.00	404.00	--	--
A61	9/2/1998	ND	ND	0.70	0.70	9.00	<5	ND	ND	149.00	20.00	--	--	--	--	262.00	247.00	ND	ND
A61	6/23/1999	ND	ND	0.60	<.6	14.90	<b>8.00</b>	ND	ND	733.30	13.30	--	--	--	--	308.40	162.10	ND	ND
A62	9/9/1991	--	--	0.60	0.50	5.00	<b>5.00</b>	ND	ND	29.00	ND	--	--	--	--	300.00	290.00	ND	ND
A62	6/25/1992	--	--	--	0.37	--	<4	--	--	--	ND	--	--	--	--	89.00	--	--	
A62	10/15/1992	--	--	--	0.52	--	<4	--	--	--	ND	--	--	--	--	--	--	--	
A62	7/20/1993	--	--	--	0.40	--	<4	--	--	--	ND	--	--	--	--	--	--	--	
A62	10/23/1996	--	--	0.79	0.89	4.30	0.90	--	--										

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Cobalt	Dissolved Cobalt	Total Cadmium	Dissolved Cadmium	Total Copper	Dissolved Copper	Total Chromium	Dissolved Chromium	Total Iron	Dissolved Iron	Total Mercury	Dissolved Mercury	Total Lithium	Dissolved Lithium	Total Manganese	Dissolved Manganese	Total Nickel	Dissolved Nickel
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	--	--	<b>2.2</b>	--	<b>2.7</b>	--	<b>24</b>	--	<b>1,000</b>	--	--	--	--	--	<b>2,179</b>	--	<b>16</b>
A62	4/18/1997	--	--	3.86	<b>3.93</b>	29.90	<b>3.90</b>	--	--	116.00	0.00	--	--	--	--	2970.00	<b>2770.00</b>	--	--
A62	9/8/1997	--	--	0.25	0.28	2.20	0.30	--	--	0.00	0.00	--	--	--	--	238.00	221.00	--	--
A62	9/2/1998	ND	ND	ND	<.6	6.00	<b>5.00</b>	ND	ND	10.00	ND	--	--	--	--	245.00	243.00	ND	ND
A62	6/23/1999	ND	ND	ND	<.6	ND	<5	ND	ND	92.20	11.10	--	--	--	--	70.90	77.90	ND	ND
A63	9/9/1991	--	--	4.00	<b>3.20</b>	ND	<4	ND	ND	64.00	28.00	--	--	--	--	24.00	23.00	ND	ND
A63	10/15/1992	--	--	--	<b>2.80</b>	--	<4	--	--	--	--	--	--	--	--	--	--	--	--
A63	7/20/1993	--	--	--	<b>2.90</b>	--	<4	--	--	--	11.00	--	--	--	--	--	--	--	--
A64	9/9/1991	--	--	0.90	1.30	5.00	<4	ND	ND	70.00	29.00	--	--	--	--	220.00	220.00	ND	ND
A64	6/25/1992	--	--	1.60	1.60	9.00	<b>7.00</b>	--	--	64.00	--	--	--	--	--	--	--	--	--
A64	10/15/1992	--	--	1.10	1.20	ND	<4	--	--	59.00	--	--	--	--	--	--	230.00	--	--
A64	7/20/1993	--	--	--	0.96	--	<b>9.00</b>	--	--	--	28.00	--	--	--	--	--	--	--	--
A64	9/8/1997	--	--	0.85	0.77	3.60	0.80	--	--	121.00	0.00	--	--	--	--	1168.00	1172.00	--	--
A64	9/2/1998	ND	ND	0.70	0.60	6.00	<5	ND	ND	115.00	16.00	--	--	--	--	414.00	388.00	ND	ND
A64	6/24/1999	ND	ND	0.60	<.6	12.70	<b>8.90</b>	ND	ND	516.20	10.80	--	--	--	--	393.30	255.40	ND	ND
A65	9/9/1991	--	--	1.00	0.90	5.00	<4	ND	ND	97.00	32.00	--	--	--	--	260.00	250.00	ND	ND
A65	6/25/1992	--	--	1.70	1.70	12.00	<b>5.00</b>	--	--	70.00	--	--	--	--	--	--	--	--	--
A65	10/15/1992	--	--	1.00	1.10	ND	<4	--	--	67.00	--	--	--	--	--	--	400.00	--	--
A65	7/20/1993	--	--	--	1.00	--	<b>4.00</b>	--	--	--	29.00	--	--	--	--	--	--	--	--
A66	9/9/1991	--	--	1.00	1.00	ND	<4	ND	ND	77.00	29.00	--	--	--	--	310.00	300.00	ND	ND
A66	6/25/1992	--	--	--	1.70	--	<b>7.00</b>	--	--	--	--	--	--	--	--	--	--	--	--
A66	10/15/1992	--	--	--	1.20	--	<4	--	--	--	--	--	--	--	--	--	--	--	--
A66	7/20/1993	--	--	--	0.99	--	<b>4.00</b>	--	--	--	28.00	--	--	--	--	--	--	--	--
A66	9/2/1998	ND	ND	0.80	0.60	6.00	<b>7.00</b>	ND	ND	152.00	19.00	--	--	--	--	648.00	620.00	ND	ND
A66	6/23/1999	ND	ND	0.60	<.6	13.20	<b>6.10</b>	ND	ND	603.70	9.40	--	--	--	--	429.60	268.10	ND	ND
A67	9/9/1991	--	--	0.60	0.60	ND	<4	ND	ND	58.00	24.00	--	--	--	--	9.00	7.00	ND	ND
A67	6/25/1992	--	--	0.73	0.69	--	<4	--	--	56.00	--	--	--	--	--	--	--	--	--
A67	10/15/1992	--	--	ND	<.25	ND	<4	--	--	100.00	--	--	--	--	--	--	ND	--	--
A67	6/15/2007	--	--	0.5	0.4	<10	<10	--	--	221	<100	--	--	--	--	23	10	<2	<2
A68	9/5/1991	--	--	1.20	1.10	8.00	<b>6.00</b>	ND	ND	99.00	60.00	--	--	--	--	370.00	360.00	ND	ND
A68	9/6/1991	--	--	1.50	1.40	10.00	<4	ND	ND	430.00	54.00	--	--	--	--	440.00	400.00	ND	ND
A68	9/7/1991	--	--	2.10	1.90	18.00	<4	ND	ND	710.00	37.00	--	--	--	--	760.00	690.00	ND	ND
A68	9/9/1991	--	--	1.10	1.10	6.00	<b>4.00</b>	ND	ND	74.00	29.00	--	--	--	--	300.00	300.00	ND	ND
A68	9/10/1991	--	--	1.50	1.40	10.00	<4	ND	ND	230.00	42.00	--	--	--	--	580.00	560.00	ND	ND
A68	12/8/1991	--	--	1.35	1.31	4.80	<b>3.00</b>	--	--	0.00	0.00	--	--	--	--	548.00	531.00	--	--
A68	1/15/1992	--	--	1.12	1.22	3.20	2.60	--	--	0.00	210.00	--	--	--	--	628.00	619.00	--	--
A68	2/13/1992	--	--	0.96	0.93	2.60	<b>2.90</b>	--	--	161.00	0.00	--	--	--	--	540.00	505.00	--	--
A68	3/5/1992	--	--	1.16	1.07	4.10	<b>2.80</b>	--	--	204.00	135.00	--	--	--	--	538.00	501.00	--	--
A68	3/16/1992	--	--	1.33	1.25	8.90	<b>3.10</b>	--	--	185.00	0.00	--	--	--	--	588.00	577.00	--	--
A68	4/13/1992	--	--	1.76	1.74	18.00	<b>9.50</b>	--	--	1039.00	203.00	--	--	--	--	765.00	700.00	--	--
A68	4/20/1992	--	--	1.62	1.65	13.20	<b>7.90</b>	--	--	222.00	0.00	--	--	--	--	508.00	493.00	--	--
A68	4/30/1992	--	--	1.38	1.34	23.90	<b>14.10</b>	--	--	294.00	0.00	--	--	--	--	360.00	312.00	--	--
A68	5/5/1992	--	--	1.67	1.54	27.30	<b>17.50</b>	--	--	236.00	0.00	--	--	--	--	425.00	377.00	--	--
A68	5/11/1992	--	--	1.77	1.71	30.20	<b>23.30</b>	--	--	201.00	0.00	--	--	--	--	456.00	438.00	--	--
A68	5/18/1992	--	--	1.43	1.35	20.30	<b>11.50</b>	--	--	235.00	0.00	--	--	--	--	365.00	310.00	--	--
A68	5/26/1992	--	--	1.24	1.18	15.10	<b>9.20</b>	--	--	135.00	0.00	--	--	--	--	332.00</td			

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Cobalt	Dissolved Cobalt	Total Cadmium	Dissolved Cadmium	Total Copper	Dissolved Copper	Total Chromium	Dissolved Chromium	Total Iron	Dissolved Iron	Total Mercury	Dissolved Mercury	Total Lithium	Dissolved Lithium	Total Manganese	Dissolved Manganese	Total Nickel	Dissolved Nickel
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>	--	--	--	<b>2.2</b>	--	<b>2.7</b>	--	<b>24</b>	--	<b>1,000</b>	--	--	--	--	--	<b>2,179</b>	--	<b>16</b>	
A68	6/1/1992	--	--	1.44	1.42	16.60	<b>11.90</b>	--	--	139.00	0.00	--	--	--	--	392.00	373.00	--	
A68	6/8/1992	--	--	1.33	1.21	13.90	<b>9.00</b>	--	--	119.00	0.00	--	--	--	--	379.00	329.00	--	
A68	6/15/1992	--	--	1.39	1.29	10.70	<b>6.10</b>	--	--	193.00	0.00	--	--	--	--	490.00	444.00	--	
A68	6/22/1992	--	--	1.10	1.12	8.60	<b>5.00</b>	--	--	158.00	0.00	--	--	--	--	376.00	345.00	--	
A68	6/23/1992	--	--	1.40	1.40	4.00	<b>6.00</b>	--	--	43.00	26.00	ND	--	--	--	--	400.00	--	--
A68	6/24/1992	--	--	1.70	1.70	16.00	<b>6.00</b>	--	--	130.00	--	--	--	--	--	--	--	--	--
A68	6/25/1992	--	--	2.10	1.80	21.00	<b>7.00</b>	--	--	260.00	--	--	--	--	--	--	--	--	--
A68	7/14/1992	--	--	0.94	0.90	7.40	<b>4.10</b>	--	--	0.00	0.00	--	--	--	--	325.00	291.00	--	--
A68	7/21/1992	--	--	0.97	0.97	8.30	<b>8.00</b>	--	--	0.00	152.00	--	--	--	--	325.00	319.00	--	--
A68	7/27/1992	--	--	1.40	1.37	14.00	<b>5.30</b>	--	--	134.00	0.00	--	--	--	--	625.00	561.00	--	--
A68	8/10/1992	--	--	1.40	1.23	11.10	<b>6.60</b>	--	--	159.00	0.00	--	--	--	--	408.00	396.00	--	--
A68	8/24/1992	--	--	2.57	2.14	41.40	<b>7.30</b>	--	--	2394.00	0.00	--	--	--	--	1107.00	882.00	--	--
A68	9/15/1992	--	--	1.53	--	11.9	--	--	--	197	--	--	--	--	--	542	--	--	--
A68	9/16/1992	--	--	1.06	0.96	11.40	<b>5.50</b>	--	--	781.00	0.00	--	--	--	--	507.00	421.00	--	--
A68	10/14/1992	--	--	0.89	0.83	4.50	<b>3.50</b>	--	--	117.00	0.00	--	--	--	--	458.00	459.00	--	--
A68	10/14/1992	--	--	1.20	1.20	5.00	<4	--	--	46.00	--	--	--	--	--	--	500.00	--	--
A68	10/15/1992	--	--	1.30	1.20	ND	2.50	--	--	--	ND	--	--	--	--	--	520.00	--	--
A68	11/18/1992	--	--	0.74	0.76	4.00	<b>3.80</b>	--	--	112.00	0.00	--	--	--	--	483.00	457.00	--	--
A68	12/16/1992	--	--	0.93	0.93	4.00	<b>3.00</b>	--	--	142.00	0.00	--	--	--	--	607.00	580.00	--	--
A68	1/13/1993	--	--	1.07	1.00	7.30	<b>4.00</b>	--	--	255.00	0.00	--	--	--	--	610.00	559.00	--	--
A68	2/17/1993	--	--	0.86	0.78	4.30	<b>3.20</b>	--	--	263.00	0.00	--	--	--	--	621.00	577.00	--	--
A68	3/10/1993	--	--	0.91	0.88	3.80	2.50	--	--	217.00	0.00	--	--	--	--	687.00	663.00	--	--
A68	3/31/1993	--	--	4.64	<b>4.49</b>	22.50	<b>10.60</b>	--	--	551.00	0.00	--	--	--	--	1590.00	1465.00	--	--
A68	4/14/1993	--	--	5.29	<b>5.04</b>	76.80	<b>10.40</b>	--	--	5739.00	0.00	--	--	--	--	2350.00	<b>2280.00</b>	--	--
A68	4/21/1993	--	--	5.43	<b>5.27</b>	75.60	<b>10.70</b>	--	--	6037.00	409.00	--	--	--	--	2845.00	<b>2710.00</b>	--	--
A68	4/29/1993	--	--	4.81	<b>4.68</b>	37.20	<b>18.00</b>	--	--	1916.00	436.00	--	--	--	--	2116.00	1980.00	--	--
A68	5/4/1993	--	--	5.85	<b>4.65</b>	43.80	<b>14.50</b>	--	--	1227.00	102.00	--	--	--	--	1790.00	1775.00	--	--
A68	5/12/1993	--	--	3.26	<b>2.92</b>	47.40	<b>12.20</b>	--	--	2392.00	0.00	--	--	--	--	1451.00	1217.00	--	--
A68	5/26/1993	--	--	2.53	1.09	51.90	<b>12.90</b>	--	--	1037.00	132.00	--	--	--	--	631.00	254.00	--	--
A68	6/2/1993	--	--	2.04	1.63	28.70	<b>11.00</b>	--	--	865.00	0.00	--	--	--	--	714.00	374.00	--	--
A68	6/9/1993	--	--	2.24	2.09	19.60	<b>12.50</b>	--	--	130.00	364.00	--	--	--	--	627.00	563.00	--	--
A68	6/16/1993	--	--	2.51	1.10	69.60	<b>8.50</b>	--	--	1147.00	0.00	--	--	--	--	1827.00	273.00	--	--
A68	6/23/1993	--	--	1.79	1.47	19.60	<b>6.60</b>	--	--	736.00	374.00	--	--	--	--	526.00	318.00	--	--
A68	7/14/1993	--	--	1.95	1.04	5.50	<b>5.30</b>	--	--	0.00	0.00	--	--	--	--	278.00	278.00	--	--
A68	7/20/1993	--	--	0.98	1.04	5.00	<b>6.00</b>	--	--	59.00	28.00	0.3	--	--	--	--	--	--	--
A68	7/21/1993	--	--	1.46	1.26	6.50	<b>3.80</b>	--	--	167.00	0.00	--	--	--	--	353.00	318.00	--	--
A68	7/21/1993	--	--	1.05	0.98	8.00	<4	--	--	58.00	44.00	--	--	--	--	--	--	--	--
A68	7/28/1993	--	--	1.08	1.12	3.50	<b>2.90</b>	--	--	0.00	0.00	--	--	--	--	340.00	326.00	--	--
A68	8/11/1993	--	--	1.15	0.25	6.00	<b>1.60</b>	--	--	0.00	0.00	--	--	--	--	446.00	84.00	--	--
A68	8/25/1993	--	--	1.13	1.03	3.80	<b>3.40</b>	--	--	0.00	0.00	--	--	--	--	436.00	401.00	--	--
A68	9/15/1993	--	--	1.29	1.26	6.40	<b>4.80</b>	--	--	250.00	0.00	--	--	--	--	485.00	472.00	--	--
A68	10/13/1993	--	--	1.18	1.19	4.90	<b>4.20</b>	--	--	112.00	0.00	--	--	--	--	701.00	679.00	--	--
A68	11/17/1993	--	--	1.26	1.24	4.50	<b>4.20</b>	--	--	154.00	161.00	--	--	--	--	836.00	833.00	--	--
A68	12/15/1993	--	--	1															

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Cobalt	Dissolved Cobalt	Total Cadmium	Dissolved Cadmium	Total Copper	Dissolved Copper	Total Chromium	Dissolved Chromium	Total Iron	Dissolved Iron	Total Mercury	Dissolved Mercury	Total Lithium	Dissolved Lithium	Total Manganese	Dissolved Manganese	Total Nickel	Dissolved Nickel
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>	--	--	--	<b>2.2</b>	--	<b>2.7</b>	--	<b>24</b>	--	<b>1,000</b>	--	--	--	--	--	<b>2,179</b>	--	<b>16</b>	
A68	5/11/1994	--	--	2.72	<b>2.38</b>	23.70	<b>14.90</b>	--	--	278.00	0.00	--	--	--	--	1309.00	1243.00	--	--
A68	5/18/1994	--	--	1.77	1.59	23.30	<b>16.00</b>	--	--	286.00	108.00	--	--	--	--	567.00	494.00	--	--
A68	5/24/1994	--	--	1.58	1.44	20.7	<b>16.9</b>	--	--	278	151	--	--	--	--	529	510	--	--
A68	6/1/1994	--	--	1.56	1.30	19.20	<b>8.30</b>	--	--	431.00	0.00	--	--	--	--	555.00	375.00	--	--
A68	6/8/1994	--	--	<.1	<.1	0.00	<b>1.50</b>	--	--	0.00	0.00	--	--	--	--	0.00	0.00	--	--
A68	6/15/1994	--	--	1.11	1.01	8.00	<b>5.30</b>	--	--	146.00	0.00	--	--	--	--	401.00	362.00	--	--
A68	6/22/1994	--	--	0.98	0.91	8.30	<b>4.90</b>	--	--	158.00	0.00	--	--	--	--	359.00	307.00	--	--
A68	7/13/1994	--	--	0.86	0.86	5.10	<b>4.90</b>	--	--	104.00	107.00	--	--	--	--	465.00	441.00	--	--
A68	7/20/1994	--	--	0.98	0.94	5.60	<b>3.90</b>	--	--	132.00	0.00	--	--	--	--	503.00	480.00	--	--
A68	7/27/1994	--	--	0.89	0.84	4.70	<b>4.10</b>	--	--	194.00	126.00	--	--	--	--	489.00	551.00	--	--
A68	8/10/1994	--	--	1.06	0.86	2.80	<b>2.50</b>	--	--	118.00	0.00	--	--	--	--	521.00	507.00	--	--
A68	8/24/1994	--	--	1.07	1.09	2.50	<b>1.80</b>	--	--	125.00	0.00	--	--	--	--	580.00	582.00	--	--
A68	9/15/1994	--	--	1.07	1.06	5.10	<b>4.40</b>	--	--	113.00	0.00	--	--	--	--	519.00	496.00	--	--
A68	10/13/1994	--	--	0.93	0.93	8.60	<b>6.20</b>	--	--	129.00	0.00	--	--	--	--	519.00	576.00	--	--
A68	11/9/1994	--	--	1.18	1.14	4.50	<b>3.10</b>	--	--	159.00	0.00	--	--	--	--	888.00	838.00	--	--
A68	11/9/1994	--	--	2.00	1.50	28.00	<b>10.00</b>	ND	ND	2810.00	ND	ND	ND	0	0	366.00	957.00	ND	ND
A68	12/13/1994	--	--	1.24	1.16	6.20	<b>3.90</b>	--	--	175.00	133.00	--	--	--	--	1121.00	1081.00	--	--
A68	1/18/1995	--	--	1.20	1.12	6.20	<b>4.60</b>	--	--	153.00	0.00	--	--	--	--	1202.00	1155.00	--	--
A68	2/15/1995	--	--	1.47	1.50	6.80	<b>4.00</b>	--	--	236.00	0.00	--	--	--	--	1215.00	1170.00	--	--
A68	3/1/1995	--	--	1.84	1.78	13.00	<b>14.60</b>	--	--	247.00	169.00	--	--	--	--	1750.00	1770.00	--	--
A68	3/15/1995	--	--	1.96	2.01	16.3	<b>8.3</b>	--	--	378	0	--	--	--	--	1870	1850	--	--
A68	4/6/1995	--	--	2.03	1.87	--	<b>8.30</b>	--	--	217.00	253.00	--	--	--	--	2124.00	2067.00	--	--
A68	4/12/1995	--	--	1.86	1.70	--	<b>11.60</b>	--	--	774.00	112.00	--	--	--	--	1882.00	1831.00	--	--
A68	4/12/1995	ND	ND	--	--	20.00	<1	ND	ND	350.00	ND	ND	ND	--	--	2050.00	1990.00	ND	ND
A68	4/19/1995	--	--	2.64	<b>2.72</b>	17.1	<b>9.2</b>	--	--	301	0	--	--	--	--	1900	--	--	--
A68	5/3/1995	--	--	3.00	<b>2.70</b>	18.30	<b>9.50</b>	--	--	406.00	0.00	--	--	--	--	234.00	<b>2200.00</b>	--	--
A68	5/10/1995	--	--	3.48	<b>3.21</b>	26.3	<b>9.3</b>	--	--	678	118	--	--	--	--	3060	290	--	--
A68	5/22/1995	--	--	1.63	1.61	47	<b>16.4</b>	--	--	818	0	--	--	--	--	1014	827	--	--
A68	5/31/1995	--	--	1.64	1.59	30.50	<b>7.20</b>	--	--	198.00	0.00	--	--	--	--	1183.00	1170.00	--	--
A68	6/7/1995	--	--	1.47	1.17	21.90	<b>14.40</b>	--	--	545.00	0.00	--	--	--	--	636.00	493.00	--	--
A68	6/14/1995	--	--	1.62	0.89	60.50	<b>15.30</b>	--	--	5120.00	144.00	--	--	--	--	1542.00	351.00	--	--
A68	6/21/1995	--	--	1.31	0.99	27.40	<b>15.10</b>	--	--	924.00	0.00	--	--	--	--	656.00	321.00	--	--
A68	6/21/1995	ND	ND	--	--	63.00	<b>6.00</b>	ND	ND	720.00	470.00	ND	ND	--	--	720.00	694.00	ND	ND
A68	6/28/1995	--	--	1.15	1.16	19.20	<b>6.80</b>	--	--	571.00	131.00	--	--	--	--	483.00	310.00	--	--
A68	7/5/1995	--	--	1.04	1.06	8.20	<b>9.20</b>	--	--	187.00	160.00	--	--	--	--	414.00	397.00	--	--
A68	7/12/1995	--	--	1.36	0.75	40	<b>6</b>	--	--	1878	104	--	--	--	--	785	192	--	--
A68	7/19/1995	--	--	1.04	1.01	7.90	<b>8.60</b>	--	--	251.00	0.00	--	--	--	--	399.00	346.00	--	--
A68	8/2/1995	--	--	0.78	0.80	4.90	<b>4.60</b>	--	--	133.00	0.00	--	--	--	--	399.00	374.00	--	--
A68	8/16/1995	--	--	0.79	0.73	6.60	<b>5.60</b>	--	--	0.00	0.00	--	--	--	--	504.00	490.00	--	--
A68	9/6/1995	ND	ND	3.00	1.10	11.00	<1	7.00	ND	510.00	20.00	ND	ND	--	--	723.00	674.00	ND	ND
A68	9/13/1995	--	--	0.92	--	6.6	0	--	--	473	0	--	--	--	--	745	--	--	--
A68	10/11/1995	--	--	0.97	0.94	5.80	<b>6.60</b>	--	--	158.00	0.00	--	--	--	--	899.00	861.00	--	--
A68	11/15/1995	--	--	0.97	1	7.1	<b>5.4</b>	--	--	214	0	--	--	--	--	1140	1112	--	--
A68	11/29/1995																		

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Cobalt	Dissolved Cobalt	Total Cadmium	Dissolved Cadmium	Total Copper	Dissolved Copper	Total Chromium	Dissolved Chromium	Total Iron	Dissolved Iron	Total Mercury	Dissolved Mercury	Total Lithium	Dissolved Lithium	Total Manganese	Dissolved Manganese	Total Nickel	Dissolved Nickel
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	--	--	<b>2.2</b>	--	<b>2.7</b>	--	<b>24</b>	--	<b>1,000</b>	--	--	--	--	--	<b>2,179</b>	--	<b>16</b>
A68	4/17/1996	--	--	--	--	--	<b>8.40</b>	--	--	--	--	--	--	--	--	--	--	--	
A68	5/1/1996	--	--	1.96	1.89	18.00	--	--	--	358.00	0.00	--	--	--	824.00	710.00	--	--	
A68	5/8/1996	--	--	1.61	1.54	30.80	<b>9.50</b>	--	--	462.00	0.00	--	--	--	631.00	406.00	--	--	
A68	5/15/1996	--	--	1.35	0.98	21.20	<b>13.50</b>	--	--	653.00	128.00	--	--	--	440.00	265.00	--	--	
A68	5/21/1996	ND	ND	ND	<5	19.00	<b>6.00</b>	ND	ND	600.00	30.00	ND	ND	--	400.00	240.00	10.00	ND	
A68	5/29/1996	--	--	1.17	1.42	6.20	<b>9.20</b>	--	--	0.00	0.00	--	--	--	467.00	445.00	--	--	
A68	6/5/1996	--	--	0.93	0.95	8.80	<b>6.30</b>	--	--	201.00	103.00	--	--	--	304.00	325.00	--	--	
A68	6/12/1996	--	--	0.84	0.82	6.20	<b>6.30</b>	--	--	101.00	0.00	--	--	--	320.00	307.00	--	--	
A68	6/19/1996	--	--	0.69	0.88	6.10	<b>3.80</b>	--	--	0.00	0.00	--	--	--	337.00	307.00	--	--	
A68	6/26/1996	--	--	0.96	0.77	6.60	<b>3.90</b>	--	--	0.00	0.00	--	--	--	334.00	308.00	--	--	
A68	7/3/1996	--	--	--	--	--	<b>3.90</b>	--	--	--	--	--	--	--	--	--	--	--	
A68	7/10/1996	--	--	0.71	0.72	5.40	--	--	--	206.00	0.00	--	--	--	455.00	440.00	--	--	
A68	7/16/1996	ND	ND	1.00	1.00	6.00	<5	ND	ND	80.00	30.00	ND	ND	--	490.00	470.00	ND	ND	
A68	7/17/1996	--	--	0.67	0.85	4.40	<b>3.40</b>	--	--	115.00	122.00	--	--	--	432.00	427.00	--	--	
A68	8/7/1996	--	--	0.84	0.99	3.90	<b>3.60</b>	--	--	193.00	120.00	--	--	--	628.00	629.00	--	--	
A68	8/14/1996	ND	ND	ND	<5	ND	<5	ND	5.00	90.00	20.00	ND	ND	--	800.00	810.00	ND	ND	
A68	8/21/1996	--	--	1.09	1.02	3.40	<b>5.50</b>	--	--	204.00	137.00	--	--	--	764.00	753.00	--	--	
A68	9/18/1996	--	--	1.42	1.07	8.90	<b>2.90</b>	--	--	657.00	162.00	--	--	--	761.00	684.00	--	--	
A68	10/1/1996	0	0	1.50	1.10	0.00	<b>0.00</b>	0.00	0.00	98.50	28.60	--	--	--	672.30	678.00	0.00	0.00	
A68	10/1/1996	0	0	1.50	1.10	0.00	<b>0.00</b>	0.00	0.00	98.50	28.60	--	--	--	672.30	678.00	0.00	0.00	
A68	10/16/1996	--	--	0.97	0.74	7.20	<b>3.70</b>	--	--	181.00	0.00	--	--	--	587.00	431.00	--	--	
A68	10/23/1996	--	--	1.32	1.08	4.60	<b>1.10</b>	--	--	--	0.00	--	--	--	--	922.00	908.00	--	--
A68	11/13/1996	--	--	1.24	1.41	7.40	<b>4.10</b>	--	--	149.00	0.00	--	--	--	905.00	950.00	--	--	
A68	11/19/1996	--	--	<2	<b>4.14</b>	5.51	<b>6.11</b>	<15	<15	115.40	<30	--	--	<6	8.6	1183.17	1206.45	<20	<20
A68	1/7/1997	<5	<5	<5	<5	14.00	<b>5.00</b>	<5	<5	160.00	10.00	<.1	<.1	--	--	2500.00	<b>2500.00</b>	<10	<10
A68	1/8/1997	--	--	2.05	<b>4.48</b>	8.12	<4	<15	<15	154.69	<30	--	--	<6	1694.54	1588.60	<20	<20	
A68	1/30/1997	--	--	2.16	<b>4.57</b>	9.03	<b>4.81</b>	<15	<15	203.06	67.88	--	--	6.5	16.8	2948.41	<b>2834.15</b>	<20	<20
A68	2/25/1997	--	--	3.39	<b>3.22</b>	15.86	<b>4.07</b>	<15	<15	450.11	78.96	--	--	6.5	<6	2025.61	1952.77	<20	<20
A68	3/5/1997	ND	ND	ND	<5	11.00	<5	ND	ND	110.00	20.00	ND	ND	--	--	3200.00	<b>3200.00</b>	ND	10.00
A68	3/12/1997	--	--	2.40	<b>2.58</b>	16.10	<b>6.00</b>	--	--	496.00	0.00	--	--	--	--	2160.00	2168.00	--	--
A68	3/19/1997	--	--	3.56	<b>3.27</b>	62.60	<b>9.60</b>	--	--	1980.00	199.00	--	--	--	--	3100.00	<b>3040.00</b>	--	--
A68	3/25/1997	--	--	4.54	<b>6.72</b>	26.40	<b>6.54</b>	<15	<15	521.31	119.50	--	--	<6	<6	2810.25	<b>2387.35</b>	<20	<20
A68	4/2/1997	--	--	2.57	<b>2.49</b>	37.00	<b>11.40</b>	--	--	394.00	0.00	--	--	--	--	2390.00	<b>2350.00</b>	--	--
A68	4/16/1997	--	--	2.87	<b>2.61</b>	79.00	2.60	--	--	459.00	0.00	--	--	--	--	1901.00	1868.00	--	--
A68	4/16/1997	--	--	2.95	<b>2.72</b>	21.00	<b>19.40</b>	--	--	525.00	0.00	--	--	--	--	3140.00	<b>2380.00</b>	--	--
A68	4/29/1997	--	--	<2	<b>5.42</b>	24.72	<b>9.65</b>	<15	<15	239.70	<30	--	--	<6	<6	1799.48	1806.54	<20	<20
A68	4/30/1997	--	--	2.52	2.05	34.50	<b>7.20</b>	--	--	667.00	120.00	--	--	--	--	1963.00	1826.00	--	--
A68	5/7/1997	ND	ND	ND	<5	33.00	<b>14.00</b>	ND	ND	420.00	60.00	ND	ND	--	--	1200.00	1100.00	10.00	ND
A68	5/14/1997	--	--	<2	<2	41.66	<b>14.55</b>	<15	<15	1063.08	54.54	--	--	<6	<6	1049.39	585.28	<20	<20
A68	5/21/1997	--	--	<2	<2	15.32	<b>5.96</b>	<15	<15	191.01	<30	--	--	<6	<6	450.73	424.66	<20	<20
A68	5/21/1997	--	--	1.45	1.08	21.00	<b>12.10</b>	--	--	344.00	184.00	--	--	--	--	476.00	422.00	--	--
A68	5/28/1997	--	--	1.22	1.22	14.10	<b>15.60</b>	--	--	114.00	0.00</								

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Cobalt	Dissolved Cobalt	Total Cadmium	Dissolved Cadmium	Total Copper	Dissolved Copper	Total Chromium	Dissolved Chromium	Total Iron	Dissolved Iron	Total Mercury	Dissolved Mercury	Total Lithium	Dissolved Lithium	Total Manganese	Dissolved Manganese	Total Nickel	Dissolved Nickel
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>	--	--	--	<b>2.2</b>	--	<b>2.7</b>	--	<b>24</b>	--	<b>1,000</b>	--	--	--	--	--	<b>2,179</b>	--	<b>16</b>	
A68	7/1/1997	--	--	<2	<2	7.71	<4	<15	<15	85.73	<30	--	--	<6	<6	185.59	305.95	<20	<20
A68	7/2/1997	--	--	0.00	--	3.40	<b>9.10</b>	--	--	63.00	0.00	--	--	--	--	176.00	--	--	
A68	7/9/1997	ND	ND	1.10	1.20	6.00	<5	ND	ND	230.00	110.00	ND	ND	--	--	470.00	440.00	ND	ND
A68	7/15/1997	--	--	<2	<2	<4	<4	<15	<15	184.85	49.62	--	--	<6	<6	364.31	378.25	<20	20.62
A68	7/16/1997	--	--	0.79	0.77	7.50	<b>4.00</b>	--	--	252.00	135.00	--	--	--	--	432.00	386.00	--	--
A68	7/30/1997	--	--	2.66	<2	4.10	<4	16.27	<15	200.41	<30	--	--	<6	8.5	428.08	493.43	<20	<20
A68	8/12/1997	--	--	<2	<2	4.15	<4	22.62	<15	274.33	120.45	--	--	<6	8.5	641.10	722.75	25.31	<20
A68	8/13/1997	--	--	--	1.00	--	<10	--	--	380.00	--	--	--	--	--	1360.00	--	--	
A68	8/13/1997	--	--	0.83	0.92	6.60	<b>3.60</b>	--	--	141.00	0.00	--	--	--	--	623.00	611.00	--	--
A68	9/11/1997	--	--	1.11	1.06	4.30	1.10	--	--	251.00	0.00	--	--	--	--	1146.00	1132.00	--	--
A68	9/11/1997	ND	ND	1.30	1.20	ND	<5	ND	ND	290.00	10.00	ND	ND	--	--	1100.00	1100.00	ND	ND
A68	9/17/1997	--	--	0.91	0.91	7.00	<b>4.90</b>	--	--	423.00	0.00	--	--	--	--	691.00	669.00	--	--
A68	9/25/1997	--	--	<2	<2	6.14	<4	<15	<15	257.18	232.85	--	--	<6	<6	565.85	561.67	<20	<20
A68	10/8/1997	--	--	--	2.00	--	<10	--	--	--	70.00	--	--	--	--	--	1370.00	--	--
A68	10/15/1997	--	--	0.85	0.81	9.80	<b>5.20</b>	--	--	206.00	0.00	--	--	--	--	660.00	584.00	--	--
A68	10/22/1997	--	--	10.88	<2	41.03	<b>4.12</b>	<15	<15	64.82	95.43	--	--	15.0	8.3	798.46	777.73	<20	<20
A68	11/12/1997	--	--	1.29	1.16	7.40	<b>4.70</b>	--	--	270.00	0.00	--	--	--	--	1446.00	1451.00	--	--
A68	11/12/1997	ND	ND	1.80	1.60	6.00	<5	ND	ND	230.00	40.00	ND	ND	--	--	1600.00	1600.00	ND	ND
A68	11/25/1997	--	--	9.97	<2	22.57	<4	<15	<15	72.41	45.00	--	--	18.3	10.3	1442.43	1456.11	<20	<20
A68	12/3/1997	--	--	--	2.00	--	<10	--	--	--	40.00	--	--	--	--	--	2070.00	--	--
A68	12/17/1997	--	--	1.63	1.40	8.40	<b>5.60</b>	--	--	301.00	0.00	--	--	--	--	2030.00	1894.00	--	--
A68	12/23/1997	--	--	<2	<b>2.81</b>	<4	<4	15.46	<15	293.23	<30	--	--	<6	<6	2108.28	<b>2198.15</b>	<20	<20
A68	1/7/1998	ND	ND	2.60	<b>2.30</b>	5.00	<b>5.00</b>	ND	ND	240.00	30.00	ND	ND	--	--	23002.30	<b>2300.00</b>	ND	ND
A68	2/4/1998	--	--	--	<1	--	<10	--	--	--	40.00	--	--	--	--	--	1960.00	--	--
A68	2/12/1998	--	--	4.15	<b>3.02</b>	6.54	<4	<15	<15	628.85	<30	--	--	<6	<6	1834.58	1801.46	<20	<20
A68	3/4/1998	--	--	1.67	1.19	4.20	<b>4.20</b>	--	--	227.00	176.00	--	--	--	--	2530.00	<b>2380.00</b>	--	--
A68	3/5/1998	ND	ND	2.10	2.00	6.00	<5	ND	ND	240.00	40.00	ND	ND	--	--	2300.00	<b>2400.00</b>	ND	ND
A68	3/16/1998	--	--	5.55	<b>3.27</b>	7.38	<4	<15	<15	208.65	<30	--	--	<6	<6	2332.87	<b>2257.62</b>	<20	<20
A68	3/18/1998	--	--	2.01	1.88	9.10	<b>4.50</b>	--	--	262.00	0.00	--	--	--	--	1928.00	1883.00	--	--
A68	4/1/1998	--	--	2.98	<b>2.65</b>	12.60	<b>12.60</b>	--	--	308.00	0.00	--	--	--	--	2430.00	2080.00	--	--
A68	4/8/1998	--	--	--	<b>3.00</b>	--	<b>10.00</b>	--	--	--	60.00	--	--	--	--	--	<b>3900.00</b>	--	--
A68	4/15/1998	--	--	4.84	<b>4.45</b>	22.60	<b>10.90</b>	--	--	288.00	0.00	--	--	--	--	3460.00	<b>3480.00</b>	--	--
A68	4/23/1998	--	--	4.76	3.73	20.35	<b>6.60</b>	<15	<15	751.92	114.46	--	--	<6	<6	3678.43	<b>3448.76</b>	<20	<20
A68	4/29/1998	--	--	3.99	<b>3.72</b>	18.40	<b>9.20</b>	--	--	439.00	71.00	--	--	--	--	2890.00	<b>2610.00</b>	--	--
A68	5/5/1998	--	--	2.27	<b>2.28</b>	22.00	<b>11.90</b>	--	--	317.00	0.00	--	--	--	--	1324.00	1045.00	--	--
A68	5/6/1998	--	--	4.18	<2	17.72	<b>6.64</b>	<15	<15	236.76	55.24	--	--	<6	<6	1325.69	1265.05	<20	<20
A68	5/7/1998	ND	ND	2.50	<b>2.40</b>	19.00	<b>9.00</b>	ND	ND	250.00	40.00	ND	ND	--	--	1400.00	1400.00	ND	ND
A68	5/13/1998	--	--	1.81	1.72	24.40	<b>10.40</b>	--	--	192.00	0.00	--	--	--	--	871.00	814.00	--	--
A68	5/20/1998	--	--	1.52	1.44	24.50	<b>11.20</b>	--	--	309.00	0.00	--	--	--	--	615.00	521.00	--	--
A68	5/27/1998	--	--	1.10	1.08	15.60	<b>8.50</b>	--	--	224.00	0.00	--	--	--	--	459.00	385.00	--	--
A68	5/29/1998	--	--	<2	<2	21.16	<b>6.69</b>	<15	<15	499.19	57.45	--	--	<6	<6	536.88	322.23	22.16	<20
A68</td																			

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Cobalt	Dissolved Cobalt	Total Cadmium	Dissolved Cadmium	Total Copper	Dissolved Copper	Total Chromium	Dissolved Chromium	Total Iron	Dissolved Iron	Total Mercury	Dissolved Mercury	Total Lithium	Dissolved Lithium	Total Manganese	Dissolved Manganese	Total Nickel	Dissolved Nickel
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>	--	--	--	<b>2.2</b>	--	<b>2.7</b>	--	<b>24</b>	--	<b>1,000</b>	--	--	--	--	--	<b>2,179</b>	--	<b>16</b>	
A68	7/9/1998	--	--	2.36	<2	6.47	<4	<15	<15	56.69	44.32	--	--	<6	<6	429.43	421.27	<20	<20
A68	7/15/1998	--	--	0.77	0.79	5.50	<b>3.90</b>	--	--	124.00	0.00	--	--	--	--	573.00	560.00	--	--
A68	7/22/1998	--	--	<2	<2	5.64	<b>5.06</b>	<15	<15	124.76	<30	--	--	<6	<6	628.77	643.02	<20	<20
A68	7/22/1998	--	--	0.86	0.82	4.90	2.70	--	--	194.00	0.00	--	--	--	--	868.00	649.00	--	--
A68	8/5/1998	--	--	--	1.00	--	<4	--	--	--	160.00	--	--	--	--	--	720.00	--	--
A68	8/26/1998	--	--	0.83	0.82	5.30	<b>4.20</b>	--	--	127.00	0.00	--	--	--	--	876.00	849.00	--	--
A68	9/2/1998	ND	ND	0.90	0.90	7.00	<5	ND	ND	133.00	15.00	--	--	--	--	680.00	682.00	ND	ND
A68	9/2/1998	ND	ND	0.90	0.90	7.00	<5	ND	ND	133.00	15.00	--	--	--	--	680.00	682.00	ND	ND
A68	9/9/1998	ND	ND	1.30	1.40	15.00	<5	ND	ND	200.00	10.00	ND	ND	--	--	1200.00	1200.00	ND	ND
A68	9/16/1998	--	--	1.05	0.61	5.70	1.00	--	--	123.00	0.00	--	--	--	--	1044.00	1010.00	--	--
A68	9/30/1998	--	--	2.54	<2	4.85	<4	<15	<15	108.85	<30	--	--	7.4	<6	1250.13	1223.87	<20	<20
A68	10/7/1998	--	--	--	1.00	--	<1	--	--	--	120.00	--	--	--	--	--	1550.00	--	--
A68	11/3/1998	ND	ND	1.80	1.80	12.00	<5	ND	ND	110.00	30.00	ND	ND	--	--	2000.00	2000.00	ND	ND
A68	11/18/1998	--	--	1.52	1.51	10.40	<b>8.20</b>	--	--	196.00	0.00	--	--	--	--	1601.00	1492.00	--	--
A68	12/2/1998	--	--	--	ND	--	<b>10.00</b>	--	--	--	40.00	--	--	--	--	--	<b>3460.00</b>	--	--
A68	1/6/1999	ND	9.0	2.10	2.00	8.00	<5	ND	ND	150.00	50.00	ND	ND	--	--	3100.00	3500.00	ND	ND
A68	1/6/1999	ND	9	2.10	2.00	8.00	<5	ND	ND	150.00	50.00	ND	ND	--	--	3100.00	3500.00	ND	ND
A68	2/4/1999	--	--	--	1.00	--	<1	--	--	--	40.00	--	--	--	--	--	<b>4150.00</b>	--	--
A68	2/17/1999	--	--	0.00	<2	0.00	<4	0.00	<15	0.00	<30	--	--	0.0	10.3	0.00	<b>2379.54</b>	0.00	<20
A68	2/24/1999	--	--	6.29	<b>4.85</b>	8.20	<b>5.10</b>	--	--	238.00	<10	--	--	--	--	2780.00	<b>2600.00</b>	--	--
A68	3/3/1999	ND	7.0	2.80	<b>2.80</b>	25.00	<5	ND	ND	220.00	70.00	ND	ND	--	--	3200.00	<b>3400.00</b>	ND	ND
A68	3/17/1999	--	--	5.14	<b>4.21</b>	10.70	<b>6.60</b>	--	--	368.00	118.00	--	--	--	--	3470.00	<b>3290.00</b>	--	--
A68	4/1/1999	--	--	1.86	1.71	10.40	<b>4.00</b>	--	--	423.00	<10	--	--	--	--	1901.00	1783.00	--	--
A68	4/7/1999	--	--	--	2.00	--	<b>9.00</b>	--	--	--	40.00	--	--	--	--	--	<b>3020.00</b>	--	--
A68	4/26/1999	--	--	1.31	1.19	12.00	<b>13.30</b>	--	--	317.00	<10	--	--	--	--	1291.00	1119.00	--	--
A68	4/29/1999	--	--	0.00	<b>2.94</b>	0.00	<b>6.45</b>	0.00	<15	0.00	<30	--	--	0.0	9.3	0.00	<b>2883.50</b>	0.00	<20
A68	5/6/1999	ND	7.0	6.30	<b>6.20</b>	31.00	<b>10.00</b>	ND	ND	190.00	30.00	ND	ND	--	--	3900.00	<b>4100.00</b>	ND	ND
A68	6/9/1999	--	--	--	ND	--	<b>7.00</b>	--	--	--	90.00	--	--	--	--	--	470.00	--	--
A68	6/23/1999	ND	ND	0.60	<.6	11.50	<b>5.60</b>	ND	ND	512.30	10.10	--	--	--	--	436.70	280.00	ND	ND
A68	6/23/1999	ND	ND	0.60	<.6	11.50	<b>5.60</b>	ND	ND	512.30	10.10	--	--	--	--	436.70	280.00	ND	ND
A68	7/7/1999	--	--	--	ND	--	<1	--	--	--	180.00	--	--	--	--	--	590.00	--	--
A68	8/4/1999	<5	<5	1.20	0.90	6.00	<5	<5	<5	170.00	20.00	<.1	<.1	--	--	570.00	640.00	<5	<5
A68	8/4/1999	<5	<5	1.20	0.90	6.00	<5	<5	<5	170.00	20.00	<.1	<.1	--	--	570.00	640.00	<5	<5
A68	8/19/1999	--	--	--	<2	--	<4	--	<15	--	<30	--	--	<6	--	--	864.98	--	<20
A68	9/1/1999	<5	<5	0.90	1.00	7.00	<b>4.00</b>	<1	<1	130.00	20.00	<.1	<.1	--	--	740.00	820.00	<5	<5
A68	9/16/1999	--	--	3.09	1.70	18.50	<b>14.30</b>	--	--	206.00	58.00	--	--	--	--	1297.80	1293.30	--	--
A68	10/6/1999	--	--	--	<1	--	<b>3.00</b>	--	--	--	80.00	--	--	--	--	--	1620.00	--	--
A68	10/14/1999	--	--	1.86	1.08	23.80	<b>11.20</b>	--	--	1370.00	226.00	--	--	--	--	1649.70	880.60	--	--
A68	11/3/1999	<5	<5	1.60	1.80	6.00	<b>4.00</b>	<1	<1	140.00	20.00	<.1	<.1	--	--	2000.00	2100.00	<5	<5
A68	11/17/1999	--	--	3.84	<b>3.66</b>	16.40	<b>15.40</b>	--	--	255.00	239.00	--	--	--	--	2363.90	<b>2369.10</b>	--	--
A68	12/1/1999	--	--	--	1.00	--	<b>3.00</b>	--	--	--	40.00	--	--	--	--	--	<b>2790.00</b>	--	--
A68	1/5/2000	<5	<5	1.40	1.70	5.00	<b>3.00</b>	36.00	<1	180.00	20.00	<.1	<.1	--	--	2800.00	<b>290</b>		

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Cobalt	Dissolved Cobalt	Total Cadmium	Dissolved Cadmium	Total Copper	Dissolved Copper	Total Chromium	Dissolved Chromium	Total Iron	Dissolved Iron	Total Mercury	Dissolved Mercury	Total Lithium	Dissolved Lithium	Total Manganese	Dissolved Manganese	Total Nickel	Dissolved Nickel
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>	--	--	--	<b>2.2</b>	--	<b>2.7</b>	--	<b>24</b>	--	<b>1,000</b>	--	--	--	--	--	<b>2,179</b>	--	<b>16</b>	
A68	9/6/2000	<5	<5	1.70	1.60	11.00	<5	<1	<1	420.00	30.00	<.1	<.1	--	--	2400.00	--	<50	
A68	10/4/2000	--	--	--	1.00	--	<b>5.00</b>	--	--	--	90.00	--	--	--	--	1570.00	--	--	
A68	11/1/2000	<5	<5	1.50	1.30	11.00	<5	2.00	<1	360.00	30.00	<.1	<.1	--	--	2100.00	2000.00	<5	
A68	12/6/2000	--	--	--	<b>3.00</b>	--	<10	--	--	--	60.00	--	--	--	--	<b>2680.00</b>	--	--	
A68	1/3/2001	<5	<5	2.50	<b>2.50</b>	8.00	<5	<5	<5	180.00	70.00	<.1	<.1	--	--	4600.00	<b>4300.00</b>	5.00	
A68	2/7/2001	--	--	--	2.00	--	<5	--	--	--	30.00	--	--	--	--	<b>2630.00</b>	--	--	
A68	3/14/2001	<50	<5	2.20	<b>2.40</b>	9.00	<b>4.00</b>	<1	<1	370.00	80.00	<.1	<.1	--	--	3200.00	<b>3300.00</b>	<5	
A68	4/4/2001	--	--	--	<b>3.00</b>	--	<b>10.00</b>	--	--	--	180.00	--	--	--	--	<b>4330.00</b>	--	--	
A68	5/2/2001	<5	<5	2.40	1.90	37.00	<b>14.00</b>	1.00	<1	1000.00	110.00	0.3	<.1	--	--	1100.00	750.00	<5	
A68	6/6/2001	--	--	--	<1	--	<b>10.00</b>	--	--	--	20.00	--	--	--	--	530.00	--	--	
A68	7/6/2001	<5	<5	0.90	0.90	5.00	<b>3.00</b>	<2	<1	<100	<100	0.2	<1	--	--	600.00	580.00	5.00	
A68	8/1/2001	--	--	--	<1	--	<10	--	--	--	60.00	--	--	--	--	1110.00	--	--	
A68	10/3/2001	--	--	--	2.00	--	<b>5.00</b>	--	--	--	50.00	--	--	--	--	1710.00	--	--	
A68	12/5/2001	--	--	--	2.00	--	<10	--	--	--	40.00	--	--	--	--	<b>2850.00</b>	--	--	
A68	1/2/2002	<3	<3	2.70	<b>2.80</b>	7.90	<b>4.00</b>	<1	2.90	310.00	<500	<.1	<.1	--	--	3700.00	<b>3700.00</b>	4.60	
A68	3/6/2002	1	1	2.60	1.70	17.00	<b>13.00</b>	<5	<5	490.00	250.00	<.1	<.1	--	--	2100.00	1900.00	<5	
A68	4/3/2002	--	--	--	<1	--	<10	--	--	--	110.00	--	--	--	--	1770.00	--	--	
A68	5/1/2002	--	--	--	<1	--	<b>10.00</b>	--	--	--	50.00	--	--	--	--	820.00	--	--	
A68	6/5/2002	--	--	0.40	0.30	3.30	1.80	<1	<1	30.00	19.00	<.2	<.2	--	--	582.00	19.00	<1	
A68	6/27/2002	--	--	1.07	1.13	4.30	<b>4.40</b>	--	--	105.00	43.00	--	--	--	--	827.80	807.10	--	
A68	7/3/2002	--	--	1.30	1.30	6.00	<b>6.00</b>	<5	<5	<50	<50	<.05	0.07	--	--	947.00	950.00	<5	
A68	7/17/2002	--	--	1.58	1.39	6.00	<b>4.60</b>	--	--	75.00	85.00	--	--	--	--	1084.90	1043.70	--	
A68	8/7/2002	--	--	--	2.00	--	<10	--	--	--	40.00	--	--	--	--	1330.00	--	--	
A68	8/14/2002	--	--	1.84	1.74	4.70	<b>4.30</b>	--	--	67.00	61.00	--	--	--	--	1171.90	1112.50	--	
A68	9/4/2002	<1	<1	2.00	2.00	9.00	<b>5.00</b>	<1	<1	54.00	55.00	<1	<1	--	--	1470.00	1460.00	2.00	
A68	9/18/2002	--	--	1.79	1.67	4.90	<b>3.60</b>	--	--	67.00	34.00	--	--	--	--	1254.70	1237.70	--	
A68	10/2/2002	--	--	--	<b>3.00</b>	--	<10	--	--	--	20.00	--	--	--	--	1690.00	--	--	
A68	10/25/2002	--	--	2.10	2.13	6.10	<b>4.90</b>	--	--	73.00	43.00	--	--	--	--	1593.00	1557.60	--	
A68	11/6/2002	<1	<1	2.00	2.00	7.00	<b>5.00</b>	<1	<1	111.00	45.00	<1	<1	--	--	2000.00	2010.00	1.00	
A68	11/12/2002	--	--	2.09	2.08	8.40	<b>4.90</b>	--	--	180.00	69.00	--	--	--	--	1758.20	1741.20	--	
A68	12/4/2002	--	--	--	<b>3.00</b>	--	<b>20.00</b>	--	--	--	20.00	--	--	--	--	<b>2820.00</b>	--	--	
A68	12/8/2002	--	--	2.86	<b>2.87</b>	8.10	<b>4.00</b>	--	--	219.00	42.00	--	--	--	--	2583.20	<b>2597.50</b>	--	
A68	1/8/2003	--	--	3.44	<b>3.43</b>	10.00	<b>5.90</b>	--	--	277.00	124.00	--	--	--	--	2829.30	<b>2795.00</b>	--	
A68	1/9/2003	1	1	3.00	<b>3.00</b>	8.00	<b>4.00</b>	<1	<1	192.00	63.00	<1	<1	--	--	2440.00	<b>2430.00</b>	2.00	
A68	2/1/2003	--	--	2.83	<b>2.74</b>	9.10	<b>5.40</b>	--	--	190.00	83.00	--	--	--	--	2732.10	<b>2705.70</b>	--	
A68	2/5/2003	--	--	--	<b>3.00</b>	--	<10	--	--	--	<20	--	--	--	--	--	<b>4370.00</b>	--	
A68	3/9/2003	--	--	2.63	<b>2.39</b>	10.30	<b>5.40</b>	--	--	267.00	74.00	--	--	--	--	2721.80	<b>2656.90</b>	--	
A68	4/24/2003	--	--	2.62	<b>2.45</b>	13.70	<b>6.90</b>	--	--	225.00	67.00	--	--	--	--	2025.60	1966.80	--	
A68	5/7/2003	--	--	1.98	1.90	17.00	<b>9.80</b>	--	--	127.00	42.00	--	--	--	--	1136.30	1118.70	--	
A68	5/7/2003	<1	<1	1.80	1.76	21.59	<b>10.31</b>	<1	<1	172.50	35.50	<0.2	<0.2	--	--	1095.00	1163.50	<1	
A68	6/2/2003	--	--	1.87	0	15.7	0	--	--	446	0	--	--	--	--	560.6	0	--	
A68	7/2/2003	--	--	1.89	1.19	4.70	<b>4.00</b>	--	--	44.00	<10	--	--	--	--	1455.70	600.60	--	
A68	7/2/2003	<1	<1	1.33	1.17	6.79	<b>4.38</b>	<1	<1	80.80	38.40	<0.2	<0.2	--	--	515.00	599.40	1.64	
A68	8/14/2003	--	--	1.80															

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Cobalt	Dissolved Cobalt	Total Cadmium	Dissolved Cadmium	Total Copper	Dissolved Copper	Total Chromium	Dissolved Chromium	Total Iron	Dissolved Iron	Total Mercury	Dissolved Mercury	Total Lithium	Dissolved Lithium	Total Manganese	Dissolved Manganese	Total Nickel	Dissolved Nickel
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	--	--	<b>2.2</b>	--	<b>2.7</b>	--	<b>24</b>	--	<b>1,000</b>	--	--	--	--	--	<b>2,179</b>	--	<b>16</b>
A68	4/16/2004	--	--	5.69	<b>5.43</b>	37.50	<b>13.00</b>	--	--	340.00	34.00	--	--	--	--	3480.50	<b>3436.80</b>	--	--
A68	5/5/2004	--	--	2.87	<b>2.57</b>	39.00	<b>20.80</b>	--	--	383.00	58.00	--	--	--	--	1204.90	1174.90	--	--
A68	5/5/2004	<1	<1	2.00	1.70	41.00	<b>17.00</b>	<1	<1	470.00	100.00	<.2	<.2	--	--	1150.00	1020.00	4.00	1.00
A68	5/28/2004	--	--	1.60	0.94	15.70	<b>6.20</b>	--	--	335.00	17.00	--	--	--	--	531.30	437.40	--	--
A68	6/17/2004	--	--	1.56	1.28	8.90	<b>5.00</b>	--	--	129.00	21.00	--	--	--	--	547.40	520.40	--	--
A68	7/7/2004	<1	7	1.00	1.30	6.00	<b>3.00</b>	<1	<1	70.00	<30	<.2	<.2	--	--	662.00	632.00	<1	1.00
A68	7/7/2004	--	--	1.69	0.95	6.9	2.6	--	--	88	39	--	--	--	--	670.9	663.1	--	--
A68	8/19/2004	--	--	3.05	1.80	5.10	<b>5.60</b>	--	--	179.00	48.00	--	--	--	--	1649.10	1564.30	--	--
A68	9/1/2004	9	<1	2.00	2.00	5.00	<b>5.00</b>	<1	<1	150.00	30.00	<.2	<.2	--	--	1850.00	1710.00	<1	<5
A68	9/15/2004	--	--	2.93	<b>2.47</b>	9.8	<b>7.5</b>	--	--	144	54	--	--	--	--	1625	1432	--	--
A68	10/14/2004	--	--	1.69	0.95	6.90	2.60	--	--	88.00	39.00	--	--	--	--	670.90	663.10	--	--
A68	11/10/2004	1	7	0.60	0.20	8.00	<b>3.00</b>	1.00	1.00	200.00	40.00	0.2	0.2	--	--	2000.00	1940.00	2.00	1.00
A68	11/10/2004	--	--	1.91	1.88	6.70	<b>2.90</b>	--	--	129.00	10.00	--	--	--	--	2368.80	<b>2308.20</b>	--	--
A68	12/8/2004	--	--	2.57	<b>2.56</b>	6.10	<b>4.10</b>	--	--	176.00	71.00	--	--	--	--	2669.20	<b>2655.40</b>	--	--
A68	1/20/2005	--	--	2.27	2.08	4.14	2.16	--	--	152.91	39.20	--	--	--	--	3213.82	<b>3132.72</b>	--	--
A68	2/15/2005	--	--	3.33	<b>3.30</b>	14.55	<b>3.71</b>	--	--	360.24	78.76	--	--	--	--	4521.74	<b>4469.78</b>	--	--
A68	03/02/2005	2	10	3.7	<b>3.6</b>	15	<b>4</b>	<1	0.001	340	40	<.2	<.2	--	--	5070	<b>4540</b>	3	3
A68	3/13/2005	--	--	3.86	<b>3.73</b>	27.53	<b>5.88</b>	--	--	292.79	48.56	--	--	--	--	5085.05	<b>5009.77</b>	--	--
A68	4/9/2005	--	--	3.70	<b>3.68</b>	18.92	<b>7.43</b>	--	--	362.17	85.44	--	--	--	--	3918.36	<b>3896.78</b>	--	--
A68	5/4/2005	--	--	3.49	<b>3.41</b>	17.80	<b>5.78</b>	--	--	217.91	<10	--	--	--	--	3352.71	<b>3360.86</b>	--	--
A68	05/04/2005	2	10	3.1	<b>2.5</b>	20	7	<1	0.005	240	40	<.2	<.2	--	--	3420	<b>3290</b>	2	3
A68	6/9/2005	--	--	1.32	1.2	11.7	<b>7.1</b>	--	--	229	26	--	--	--	--	615.8	562.6	--	--
A68	7/6/2005	--	--	1.08	1.03	5.8	<b>4.5</b>	--	--	74	15	--	--	--	--	664.5	650.2	--	--
A68	07/06/2005	<1	3	1	1	6	<b>4</b>	<1	0.001	90	<30	<.2	<.2	--	--	712	710	<1	<1
A68	8/10/2005	--	--	1	1.01	5	<b>3.7</b>	--	--	111	50	--	--	--	--	1120.3	1071.7	--	--
A68	9/14/2005	--	--	1.5	1.38	4.6	2.7	--	--	112	20	--	--	--	--	1802.1	1783.5	--	--
A68	9/15/2005	1	2	1.4	1.4	5	<b>3</b>	<1	<1	110	30	<.2	<.2	--	--	1710	1660	<1	1
A68	10/13/2005	--	--	1.65	1.5	9.9	<b>7.2</b>	--	--	105	71	--	--	--	--	1489.8	1442.6	--	--
A68	11/2/2005	--	--	1.66	1.59	7.8	<b>5.4</b>	--	--	107	58	--	--	--	--	1866.8	1782.7	--	--
A68	11/2/2005	8	3	1.7	1.7	8	<b>4</b>	<1	<1	150	40	<.2	<.2	--	--	1910	1920	2	2
A68	12/20/2005	--	--	2.05	1.96	4.3	2.7	--	--	188	76	--	--	--	--	3486.2	<b>3366.2</b>	--	--
A68	1/6/2006	--	--	2.35	<b>2.21</b>	6.5	<b>4.8</b>	--	--	149	37	--	--	--	--	3897.9	<b>3770.4</b>	--	--
A68	01/06/2006	2	4	2.7	1.9	5	2	<1	<1	180	50	<.2	<.2	--	--	3900	<b>3800</b>	3	2
A68	2/8/2006	--	--	2.87	<b>2.89</b>	6.1	<b>4.3</b>	--	--	221	106	--	--	--	--	6191.1	<b>6093</b>	--	--
A68	3/15/2006	--	--	2.81	<b>2.76</b>	4.4	<b>3.1</b>	--	--	145	56	--	--	--	--	4855.8	<b>4695.1</b>	--	--
A68	03/15/2006	2	4	2.7	<b>2.8</b>	7	<b>4</b>	<1	<1	260	150	<.2	<.2	--	--	4190	<b>4200</b>	3	3
A68	4/5/2006	--	--	4.11	<b>4.07</b>	16.9	<b>5.6</b>	--	--	313	64	--	--	--	--	4528.6	<b>4517.6</b>	--	--
A68	5/10/2006	--	--	1.53	1.43	14.1	<b>10</b>	--	--	113	57	--	--	--	--	1424.5	1318.2	--	--
A68	05/10/2006	<1	4	1.5	1.6	14	<b>9</b>	<1	<1	180	140	<.2	<.2	--	--	1330	138	2	2
A68	05/16/2006	--	2	0.8	--	--	<b>7</b>	--	<1	--	<30	--	<.2	--	--	--	323	--	<1
A68	6/6/2006	--	--	1.13	0.98	7.3	<b>4</b>	--	--	222	32	--	--	--	--	631.5	544.8	--	--
A68	7/12/2006	--	--	1.06	1	3.8	<b>2</b>	--	--	75	20	--	--	--	--	1023	1012.4	--	--
A68	07/12/2006	<1																	

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Cobalt	Dissolved Cobalt	Total Cadmium	Dissolved Cadmium	Total Copper	Dissolved Copper	Total Chromium	Dissolved Chromium	Total Iron	Dissolved Iron	Total Mercury	Dissolved Mercury	Total Lithium	Dissolved Lithium	Total Manganese	Dissolved Manganese	Total Nickel	Dissolved Nickel
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	--	--	<b>2.2</b>	--	<b>2.7</b>	--	<b>24</b>	--	<b>1,000</b>	--	--	--	--	--	<b>2,179</b>	--	<b>16</b>
A68	2/6/2007	--	--	1.96	1.96	7.1	3.1	--	--	245	103	--	--	--	--	3360.7	<b>3178</b>	--	--
A68	3/7/2007	--	--	2.08	2.08	3.7	1.5	--	--	146	15	--	--	--	--	3669.8	<b>3483.6</b>	--	--
A68	03/07/2007	2	4	2.2	2.1	6	3	<1	<1	310	80	<.2	<.2	--	--	3660	<b>3650</b>	2	2
A68	4/2/2007	--	--	2.45	<b>2.34</b>	9.1	3.4	--	--	232	42	--	--	--	--	2870	<b>2784.7</b>	--	--
A68	05/11/2007	<1	3	1.4	<.2	20	10	<1	<1	270	60	<.2	<.2	--	--	1070	1040	<1	<1
A68	5/11/2007	--	--	0.98	0.9	16.3	<b>8.3</b>	--	--	162	17	--	--	--	--	933	915.9	--	--
A68	6/5/2007	--	--	1.08	0.78	10.7	<b>4.3</b>	--	--	322	14.5	--	--	--	--	443	326.8	--	--
A68	6/14/2007	--	--	1	0.9	<10	<10	--	--	<100	<100	--	--	--	--	555	518	<2	<2
A68	6/14/2007	--	--	1	0.9	<10	<10	--	--	<100	<100	--	--	--	--	555	518	<2	<2
A68	7/11/2007	--	--	1.12	0.97	8.4	<b>3.6</b>	--	--	94	34	--	--	--	--	703	683.6	--	--
A68	07/11/2007	<1	<1	1	1	5	3	<1	<1	70	<30	<.2	<.2	--	--	751	702	<1	1
A68	8/6/2007	--	--	1.33	1.08	19.8	<b>4.3</b>	--	--	657	23	--	--	--	--	548	413.5	--	--
A68	9/5/2007	--	--	1.78	1.45	7.8	<b>5.6</b>	--	--	161	26	--	--	--	--	1284.3	1223.4	--	--
A68	09/05/2007	<10	<10	<10	<10	<10	<10	<50	<50	160	70	<1	<1	--	--	1210	1300	<5	<5
A68	10/25/2007	--	--	1.37	1.35	12.2	<b>4.7</b>	--	--	132	50	--	--	--	--	1240.8	1228.1	--	--
A68	11/07/2007	<1	<1	1.6	1.6	7	3	<1	<1	170	50	<.2	<.2	--	--	1540	1530	1	1
A68	12/5/2007	--	--	1.97	1.77	6.2	<b>3.5</b>	--	--	226	131	--	--	--	--	2372	<b>2353.9</b>	--	--
A68	1/2/2008	1	1	2.10	2.10	4.00	2.00	<1	<1	190.00	50.00	<.2	<.2	--	--	2850.00	<b>2840.00</b>	2.00	2.00
A68	1/2/2008	--	--	4.89	2.07	0	1.2	--	--	0	29	--	--	--	--	3075.4	<b>2960</b>	--	--
A68	3/12/2008	2	1	4.50	<b>4.40</b>	19.00	<b>5.00</b>	<1	<1	270.00	40.00	<.2	<.2	--	--	4060.00	<b>3990.00</b>	3.00	3.00
A68	4/10/2008	--	--	7.23	<b>6.96</b>	36.9	<b>11.9</b>	--	--	264	33	--	--	--	--	8246	<b>6250</b>	--	--
A68	5/7/2008	--	--	1.82	1.7	23.5	<b>12.4</b>	--	--	242	58	--	--	--	--	1326.1	1267.7	--	--
A68	5/7/2008	<1	<1	1.80	1.80	24.00	<b>8.00</b>	<1	<1	330.00	30.00	<.1	<.2	--	--	1540.00	1510.00	<1	1.00
A68	6/3/2008	--	--	1.2	0.78	23.2	<b>6.3</b>	--	--	931	21	--	--	--	--	544.5	215.7	--	--
A68	7/9/2008	--	--	0.92	0.94	5.2	<b>3.4</b>	--	--	64	17	--	--	--	--	586.5	572.5	--	--
A68	7/9/2008	<1	<1	1.20	<b>3.00</b>	12.00	<b>3.00</b>	<1	<1	80.00	30.00	<.2	<.2	--	--	639.00	657.00	2.00	<1
A68	8/5/2008	--	--	0.98	0.9	6	<b>4.6</b>	--	--	114	66	--	--	--	--	648.7	622.7	--	--
A68	9/3/2008	--	--	1.27	1.42	5.4	<b>3.6</b>	--	--	117	41	--	--	--	--	1300.6	1270.2	--	--
A68	9/3/2008	<1	<1	1.4	1.4	5	3	<1	<1	140	50	<.2	<.2	--	--	1450	1470	1.00	<1
A68	10/6/2008	--	--	1.53	1.48	6.9	<b>5.7</b>	--	--	180	85	--	--	--	--	1599.9	1452.2	--	--
A68	11/7/2008	--	--	2.04	2.19	4.3	<b>2.9</b>	--	--	112	12	--	--	--	--	2906.4	<b>2839.6</b>	--	--
A68	11/7/2008	1	1	2.40	<b>2.30</b>	6.00	<b>3.00</b>	<1	<1	300.00	120.00	<1	<.2	--	--	2780.00	<b>2900.00</b>	2.00	2.00
A68	12/3/2008	--	--	1.69	1.7	6.2	<b>4.7</b>	--	--	225	95	--	--	--	--	2325.4	<b>2332.2</b>	--	--
A68	3/4/2009	--	--	2.65	<b>2.5</b>	11	<b>5.1</b>	--	--	214	14	--	--	--	--	3863.4	<b>3838</b>	--	--
A68	3/4/2009	2	1	2.8	<b>2.9</b>	11	<b>4</b>	<1	<1	240	40	<.2	<.2	--	--	3810	<b>3920</b>	3	3
A68	4/6/2009	--	--	2.11	2.04	14	<b>5.8</b>	--	--	452	91	--	--	--	--	2492.4	<b>2449.8</b>	--	--
A68	5/13/2009	1	<1	2.1	0.7	45	<b>4</b>	2	<1	2570	30	<.2	<.2	--	--	977	311	2	<1
A68	5/13/2009	--	--	1.42	0.76	32.3	<b>6.3</b>	--	--	1865	21	--	--	--	--	851.6	323.7	--	--
A68	5/19/2009	--	--	1.5	0.9	21.2	<b>4.5</b>	<2	<2.00	1100	<100	--	--	--	--	697	340	<2	<2.00
A68	6/2/2009	--	--	0.93	0.87	6.2	<b>4.8</b>	--	--	88	25	--	--	--	--	395.1	375.5	--	--
A68	6/16/2009	--	--	0.9	0.8	5.8	<b>3.7</b>	<2.0	<2.0	<100	<100	--	--	--	--	697	636	<2.0	<2.0
A68	7/8/2009	--	--	0.55	0.57	3.9	<b>2.8</b>	--	--	88	34	--	--	--	--	589.4	580.2	--	--
A68	7/8/2009	--	--	--	0.55	0.57	<b>3.9</b>	2.8	--	--	88	--	--	--	--	589.4	580.2	--	--

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Cobalt	Dissolved Cobalt	Total Cadmium	Dissolved Cadmium	Total Copper	Dissolved Copper	Total Chromium	Dissolved Chromium	Total Iron	Dissolved Iron	Total Mercury	Dissolved Mercury	Total Lithium	Dissolved Lithium	Total Manganese	Dissolved Manganese	Total Nickel	Dissolved Nickel
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	--	--	<b>2.2</b>	--	<b>2.7</b>	--	<b>24</b>	--	<b>1,000</b>	--	--	--	--	--	<b>2,179</b>	--	<b>16</b>
A68	11/4/2009	<1	<1	1.60	1.50	4.00	<b>3.00</b>	<1	<1	150.00	90.00	<.2	<.2	--	--	1900.00	1880.00	1.00	2.00
A68	11/5/2009	--	--	0.33	0	3.1	<1	--	--	323	0	--	--	--	--	--	--	--	--
A68	11/17/2009	--	--	1.6	1.7	5.1	<3.0	<2.0	<2.0	234	<100	--	--	--	--	2320	<b>2380</b>	<2.0	<2.0
A68	12/1/2009	--	--	1.42	1.42	5.8	<b>3.3</b>	--	--	292	107	--	--	--	--	2313.6	<b>2238.8</b>	--	--
A68	2/17/2010	--	--	2	1.8	6.2	<3.0	<2.0	<2.0	293	<100	--	--	--	--	3550	<b>3560</b>	<2.0	<2.0
A68	3/2/2010	--	--	1.58	1.55	7	<b>5</b>	--	--	385	185	--	--	--	--	2827.3	<b>2763.6</b>	--	--
A68	3/17/2010	--	--	1.7	1.6	7.7	<3.0	<2.0	<2.0	235	<100	--	--	--	--	2830	<b>2710</b>	<2.0	<2.0
A68	4/16/2010	--	--	3.21	<b>2.93</b>	15	<b>8.1</b>	--	--	222	128	--	--	--	--	4371.1	<b>4320.8</b>	--	--
A68	5/5/2010	--	--	1.33	1.23	10.1	<b>7.4</b>	--	--	135	49	--	--	--	--	1089.1	1063	--	--
A68	5/5/2010	<1	<1	1.40	1.30	10.00	<b>7.00</b>	<1	<1	120.00	50.00	<.2	<.2	--	--	1080.00	1040.00	1.00	<1
A68	6/2/2010	--	--	0.95	0.81	7.7	<b>4.3</b>	--	--	338	23	--	--	--	--	416.5	334.9	--	--
A68	6/2/2010	--	--	1.1	0.9	<10.0	<10.0	<5.0	<5.0	376	<100	--	--	--	--	435	335	<4.0	<4.0
A68	7/8/2010	--	--	0.82	0.82	3.6	<b>3.7</b>	--	--	93	52	--	--	--	--	724.4	731.6	--	--
A68	7/8/2010	<1	<1	0.80	0.80	3.00	2.00	<1	<1	90.00	50.00	<.2	<.2	--	--	784.00	748.00	<1	<1
A68	7/13/2010	--	--	0.8	0.8	<10.0	<10.0	<5.0	<5.0	<100	<100	--	--	--	--	668	649	<4.0	<4.0
A68	8/10/2010	--	--	1.19	1.18	5.4	<b>3.4</b>	--	--	145	58	--	--	--	--	1344.5	1308.9	--	--
A68	9/9/2010	--	--	0.98	0.91	4.8	<b>3</b>	--	--	134	39	--	--	--	--	11989.9	1233.9	--	--
A68	9/9/2010	<1	<1	1.20	1.20	6	<b>3.00</b>	<1	<1	140.00	30.00	<.1	<.2	--	--	1240	1180.00	1.00	1.00
A68	9/14/2010	--	--	1.3	1.3	<10.0	<10.0	<5.0	<5.0	129	<100	--	--	--	--	1280	1310	<4.0	<4.0
A68	10/4/2010	--	--	0.95	0.89	4.3	<b>3</b>	--	--	135	85	--	--	--	--	1456	1421.5	--	--
A68	11/2/2010	--	--	1.3	1.4	<10.0	<10.0	<5.0	<5.0	169	<100	--	--	--	--	1770	1790	<4.0	<4.0
A68	11/3/2010	<1	1.0	1.20	1.20	5.0	<b>3.00</b>	<1	<1	150.00	70.00	<.1	<.2	--	--	1410	1390.00	1.00	1.00
A68	11/3/2010	--	--	0.95	0.91	4.3	<b>2.8</b>	--	--	135	44	--	--	--	--	1436.8	1393.9	--	--
A68	12/7/2010	--	--	1.33	1.26	4.4	<b>3.4</b>	--	--	174	142	--	--	--	--	2210.3	1903.7	--	--
A68	1/5/2011	--	--	1.79	1.72	2.9	2.2	--	--	52	<10	--	--	--	--	2726.3	<b>2744.6</b>	--	--
A68	1/5/2011	1.0	1.0	2.20	2.00	4.0	2.00	<1	<1	90.00	<30	<.1	<.2	--	--	2710	<b>2700.00</b>	2.00	2.00
A68	2/11/2011	--	--	2.09	2	10.1	<b>4.2</b>	--	--	252	57	--	--	--	--	2753.5	<b>2600.1</b>	--	--
A68	3/9/2011	--	--	2.27	2.17	5.7	<b>3.3</b>	--	--	86	<10	--	--	--	--	3421.2	<b>3418.4</b>	--	--
A68	3/9/2011	2	2	2.6	<b>2.5</b>	13	<b>5</b>	1	<1	350	50	<.1	<.2	--	--	3740	<b>3660</b>	3	3
A68	3/15/2011	--	--	2.6	<b>2.7</b>	14.7	<10.0	<5.0	<5.0	208	<100	--	--	--	--	3200	<b>3160</b>	<4.0	<4.0
A68	4/6/2011	--	--	3.62	<b>3.44</b>	25.3	<b>9.4</b>	--	--	280	29	--	--	--	--	3753.1	<b>3650.9</b>	--	--
A68	5/4/2011	2	2	3	<b>3</b>	18	<b>6</b>	<1	<1	240	80	<.1	<.2	--	--	3170	<b>3290</b>	2	2
A68	5/8/2011	--	--	1.71	1.53	20.6	<b>7.7</b>	--	--	482	17	--	--	--	--	2057.2	1968.6	--	--
A68	6/3/2011	--	--	0.95	0.78	13.6	<b>6.6</b>	--	--	386	15	--	--	--	--	588.1	484	--	--
A68	6/14/2011	--	--	1.1	0.9	10.9	<10.0	<5.0	<5.0	544	<100	--	--	--	--	550	415	<4.0	<4.0
A68	7/5/2011	--	--	0.75	0.71	4.5	<b>2.8</b>	--	--	126	13	--	--	--	--	456.2	432.6	--	--
A68	7/19/2011	--	--	0.8	0.8	<20.0	<20.0	<5.0	<5.0	189	<100	--	--	--	--	571	537	<4.0	<4.0
A68	8/1/2011	--	--	0.7	0.68	3.7	2.4	--	--	86	34	--	--	--	--	700.8	685.8	--	--
A68	8/16/2011	--	--	1	0.9	<20.0	<20.0	<5.0	<5.0	116	<100	--	--	--	--	868	821	<4.0	<4.0
A68	9/7/2011	--	--	0.82	0.78	2.6	<b>&lt;1</b>	--	--	110	13	--	--	--	--	892.4	841.6	--	--
A68	9/7/2011	<1	<1	1.1	1.1	6	2	<1	<1	120	40	<.1	<.2	--	--	920	976	1	<1
A68	9/13/2011	--	--	1.1	1.1	<20.0	<20.0	<5.0	<5.0	158	<100	--	--	--	--	1120	1140	<4.0	<4.0
A68	1																		

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Lead	Dissolved Lead	Total Selenium	Dissolved Selenium	Total Strontium	Dissolved Strontium	Total Thallium	Dissolved Thallium	Total Vanadium	Dissolved Vanadium	Total Zinc	Dissolved Zinc	Total Sodium	Dissolved Sodium	Sulfate	Chloride	TSS	TDS
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	<b>0.5</b>	--	--	--	--	--	--	--	--	<b>280</b>	--	--	--	--	--	--	
A56	9/9/1991	<5	<5	--	--	--	--	--	--	--	--	240.00	240.00	--	--	--	--	--	
A56	6/25/1992	ND	<5	--	--	--	--	--	--	--	--	370.00	<b>360.00</b>	--	--	--	--	--	
A56	10/15/1992	<5	<5	--	ND	--	--	--	--	--	--	350.00	<b>330.00</b>	--	--	--	--	--	
A56	9/2/1998	2.90	<.6	--	--	--	--	--	--	ND	ND	255.00	250.00	--	1.64	69.9	0.74	--	
A56	6/24/1999	27.30	<.6	--	--	--	--	--	--	ND	ND	291.60	248.00	--	0.82	25.6	ND	--	
A58	9/9/1991	<5	<5	ND	ND	--	--	--	--	--	--	120.00	120.00	--	--	--	--	--	
A58	6/25/1992	ND	<5	--	--	--	--	--	--	--	--	110.00	110.00	--	--	--	--	--	
A58	10/15/1992	<5	<5	--	ND	--	--	--	--	--	--	200.00	200.00	--	--	--	--	--	
A58	9/2/1998	10.30	<b>1.80</b>	--	--	--	--	--	--	ND	ND	129.00	142.00	--	1.69	39.8	ND	--	
A58	6/22/1999	5.00	<b>1.40</b>	--	--	--	--	--	--	ND	ND	112.30	133.40	--	0.78	14.7	ND	--	
A58	7/28/2002	3.50	<3	<2	<2	--	--	--	--	--	--	178.30	187.60	--	--	--	--	--	
A58	9/3/2002	<3	<3	<2	<2	--	--	--	--	--	--	151.50	151.30	--	--	--	--	--	
A58	6/12/2003	<3	<3	--	--	--	--	--	--	--	--	122.80	123.40	--	--	--	--	--	
A58	10/19/2003	3.70	<3	<2	<2	--	--	--	--	--	--	185.40	180.10	--	--	--	--	--	
A58	6/10/2004	<3	<b>2.90</b>	3.40	3.40	--	--	--	--	--	--	146.00	138.00	--	--	--	--	--	
A58	6/19/2004	4.40	<b>2.50</b>	3.20	6.80	--	--	--	--	--	--	115.00	115.20	--	--	--	--	--	
A58	8/10/2009	--	<b>2</b>	--	<1	--	--	--	--	--	--	160	8.77	--	--	57	--	--	
A58	10/26/2009	--	<b>2.8</b>	--	<1	--	--	--	--	--	--	200	10.86	--	--	61	--	--	
A58	4/13/2010	--	<1	--	<1	--	--	--	--	--	--	56	7.94	--	--	63	--	--	
A58	7/7/2010	--	<b>1.8</b>	--	<1	--	--	--	--	--	--	140	8.98	--	--	31	--	--	
A60	9/9/1991	<5	<5	--	--	--	--	--	--	--	--	240.00	230.00	--	--	--	--	--	
A60	6/25/1992	ND	<5	--	--	--	--	--	--	--	--	340.00	<b>320.00</b>	--	--	--	--	--	
A60	10/15/1992	<5	<5	--	--	--	--	--	--	--	--	240.00	230.00	--	--	--	--	--	
A60	7/20/1993	--	<5	--	--	--	--	--	--	--	--	<b>320.00</b>	--	--	--	--	--	--	
A60	4/6/1999	0.00	<30	0.00	0.00	0.0	413.8	0.0	0.0	0.0	<4	0.00	269.00	--	1.818	--	--	--	
A60	4/27/1999	0.00	<30	0.00	0.00	0.0	414.4	0.0	0.0	0.0	<4	0.00	277.23	--	1.928	--	--	--	
A60	5/10/1999	0.00	<30	0.00	0.00	0.0	333.4	0.0	0.0	0.0	<4	0.00	<b>296.80</b>	--	1.735	--	--	--	
A60	5/28/1999	0.00	<30	0.00	0.00	0.0	212.1	0.0	0.0	0.0	<4	0.00	267.51	--	1.033	--	--	--	
A60	6/10/1999	0.00	<30	0.00	0.00	0.0	153	0.0	0.0	0.0	<4	0.00	158.64	--	0.851	30	--	--	
A60	7/15/1999	0.00	<30	0.00	0.00	0.0	207	0.0	0.0	0.0	<4	0.00	205.47	--	0.982	28	--	--	
A60	7/30/1999	--	<30	--	--	--	249.624	--	--	--	<4	--	219.53	--	1.082	--	--	--	
A60	8/19/1999	--	<30	--	--	--	284.076	--	--	--	<4	--	225.93	--	1.362	--	--	--	
A61	9/9/1991	<5	<5	--	--	--	--	--	--	--	--	280.00	260.00	--	--	--	--	--	
A61	6/25/1992	--	<5	--	--	--	--	--	--	--	--	<b>350.00</b>	--	--	--	--	--	--	
A61	10/15/1992	--	<5	--	--	--	--	--	--	--	--	<b>360.00</b>	--	--	--	--	--	--	
A61	7/20/1993	--	<5	--	--	--	--	--	--	--	--	<b>300.00</b>	--	--	--	--	--	--	
A61	10/23/1996	0.00	0.00	--	--	--	--	--	--	--	--	532.00	<b>561.00</b>	--	--	--	--	--	
A61	4/16/1997	10.10	<b>5.90</b>	--	--	--	--	--	--	--	--	1107.00	<b>1038.00</b>	--	--	--	--	--	
A61	9/8/1997	0.00	0.00	--	--	--	--	--	--	--	--	377.00	<b>333.00</b>	--	--	--	--	--	
A61	9/2/1998	6.90	<.6	--	--	--	--	--	--	ND	ND	354.00	<b>281.00</b>	--	1.69	66.7	0.67	--	
A61	6/23/1999	25.70	<.6	--	--	--	--	--	--	ND	ND	286.00	221.00	--	0.78	23.4	ND	--	
A62	9/9/1991	<5	<5	ND	ND	--	--	--	--	--	--	100.00	100.00	--	--	--	--	--	
A62	6/25/1992	--	<5	--	ND	--	--	--	--	--	--	57.00	--	--	--	--	--	--	
A62	10/15/1992	--	<5	--	ND	--	--	--	--	--	--	99.00	--	--	--	--	--	--	
A62	7/20/1993	--	<5	--	--	--	--	--	--	--	--	100.00	--	--	--	--	--	--	
A62	10/23/1996	0.00	0.00	--	--	--	--	--	--	--	--	440.00	<b>352.00</b>	--	--	--	--	--	

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Lead	Dissolved Lead	Total Selenium	Dissolved Selenium	Total Strontium	Dissolved Strontium	Total Thallium	Dissolved Thallium	Total Vanadium	Dissolved Vanadium	Total Zinc	Dissolved Zinc	Total Sodium	Dissolved Sodium	Sulfate	Chloride	TSS	TDS
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	0.5	--	--	--	--	--	--	--	--	280	--	--	--	--	--	--	
A62	4/18/1997	6.40	2.50	--	--	--	--	--	--	--	1015.00	980.00	--	--	--	--	--	--	
A62	9/8/1997	<1	<1	--	--	--	--	--	--	--	77.00	77.00	--	--	--	--	--	--	
A62	9/2/1998	0.60	<.6	--	--	--	--	--	--	ND	ND	73.00	82.00	--	1.23	31.7	ND	--	
A62	6/23/1999	2.50	<.6	--	--	--	--	--	--	ND	ND	69.80	36.30	--	0.54	8.3	ND	--	
A63	9/9/1991	<5	<5	--	--	--	--	--	--	--	960.00	940.00	--	--	--	--	--	--	
A63	10/15/1992	--	<5	--	--	--	--	--	--	--	--	500.00	--	--	--	--	--	--	
A63	7/20/1993	--	<5	--	--	--	--	--	--	--	--	560.00	--	--	--	--	--	--	
A64	9/9/1991	<5	<5	ND	ND	--	--	--	--	--	260.00	250.00	--	--	--	--	--	--	
A64	6/25/1992	<5	<5	--	--	--	--	--	--	--	360.00	340.00	--	--	--	--	--	--	
A64	10/15/1992	<5	<5	--	--	--	--	--	--	--	360.00	350.00	--	--	--	--	--	--	
A64	7/20/1993	--	<5	--	--	--	--	--	--	--	--	330.00	--	--	--	--	--	--	
A64	9/8/1997	1.10	0.00	--	--	--	--	--	--	--	342.00	308.00	--	--	--	--	--	--	
A64	9/2/1998	4.70	<.6	--	--	--	--	--	--	ND	ND	289.00	293.00	--	1.62	69.7	0.66	--	
A64	6/24/1999	22.60	<.6	--	--	--	--	--	--	ND	ND	301.70	248.60	--	0.79	25	ND	--	
A65	9/9/1991	5.00	<5	--	--	--	--	--	--	--	290.00	280.00	--	--	--	--	--	--	
A65	6/25/1992	<5	<5	--	--	--	--	--	--	--	360.00	350.00	--	--	--	--	--	--	
A65	10/15/1992	<5	<5	--	--	--	--	--	--	--	430.00	430.00	--	--	--	--	--	--	
A65	7/20/1993	--	<5	--	--	--	--	--	--	--	--	350.00	--	--	--	--	--	--	
A66	9/9/1991	5.00	<5	--	--	--	--	--	--	--	260.00	250.00	--	--	--	--	--	--	
A66	6/25/1992	--	<5	--	--	--	--	--	--	--	--	360.00	--	--	--	--	--	--	
A66	10/15/1992	--	<5	--	--	--	--	--	--	--	--	360.00	--	--	--	--	--	--	
A66	7/20/1993	--	<5	--	--	--	--	--	--	--	--	400.00	--	--	--	--	--	--	
A66	9/2/1998	5.80	<.6	--	--	--	--	--	--	ND	ND	327.00	340.00	--	1.65	71.3	0.67	--	
A66	6/23/1999	25.50	1.00	--	--	--	--	--	--	ND	ND	303.50	277.30	--	0.79	24.8	ND	--	
A67	9/9/1991	<5	<5	--	--	--	--	--	--	--	81.00	76.00	--	--	--	--	--	--	
A67	6/25/1992	<5	<5	--	--	--	--	--	--	--	71.00	68.00	--	--	--	--	--	--	
A67	10/15/1992	<5	<5	--	--	--	--	--	--	--	ND	ND	--	--	--	--	--	--	
A67	6/15/2007	11.7	1.2	--	--	--	--	--	--	--	76	69	--	615	0.011	<.5	--	--	
A68	9/5/1991	6.00	<5	ND	ND	--	--	--	--	--	310.00	290.00	2	2	87	ND	11	--	
A68	9/6/1991	29.00	<5	--	--	--	--	--	--	--	410.00	350.00	--	--	--	--	--	--	
A68	9/7/1991	96.00	5.00	--	--	--	--	--	--	--	540.00	450.00	--	--	--	--	--	--	
A68	9/9/1991	<5	<5	--	--	--	--	--	--	--	290.00	290.00	--	--	--	--	--	--	
A68	9/10/1991	25.00	<5	--	--	--	--	--	--	--	400.00	370.00	--	--	--	--	--	--	
A68	12/8/1991	<1	<1	--	--	--	--	--	--	--	513.00	540.00	--	--	--	--	--	--	
A68	1/15/1992	<1	<1	--	--	--	--	--	--	--	510.00	519.00	--	--	--	--	--	--	
A68	2/13/1992	<1	<1	--	--	--	--	--	--	--	471.00	461.00	--	--	--	--	--	--	
A68	3/5/1992	<1	<1	--	--	--	--	--	--	--	478.00	453.00	--	--	--	--	--	--	
A68	3/16/1992	<1	<1	--	--	--	--	--	--	--	489.00	480.00	--	--	--	--	--	--	
A68	4/13/1992	15.50	<1	--	--	--	--	--	--	--	599.00	557.00	--	--	--	--	--	--	
A68	4/20/1992	<1	<1	--	--	--	--	--	--	--	567.00	548.00	--	--	--	--	--	--	
A68	4/30/1992	<1	<1	--	--	--	--	--	--	--	482.00	444.00	--	--	--	--	--	--	
A68	5/5/1992	<1	<1	--	--	--	--	--	--	--	489.00	450.00	--	--	--	--	--	--	
A68	5/11/1992	<1	<1	--	--	--	--	--	--	--	513.00	479.00	--	--	--	--	--	--	
A68	5/18/1992	<1	<1	--	--	--	--	--	--	--	381.00	350.00	--	--	--	--	--	--	
A68	5/26/1992	<1	<1	--	--	--	--	--	--	--	351.00	324.00	--	--	--	--	--	--	

Table A-1

## **Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest**

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Lead	Dissolved Lead	Total Selenium	Dissolved Selenium	Total Strontium	Dissolved Strontium	Total Thallium	Dissolved Thallium	Total Vanadium	Dissolved Vanadium	Total Zinc	Dissolved Zinc	Total Sodium	Dissolved Sodium	Sulfate	Chloride	TSS	TDS
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>	--	0.5	--	--	--	--	--	--	--	--	--	280	--	--	--	--	--	--	
A68	5/11/1994	9.50	<1	--	--	--	--	--	--	--	--	888.00	871.00	--	--	--	--	--	
A68	5/18/1994	10.50	1.20	--	--	--	--	--	--	--	--	568.00	523.00	--	--	--	--	--	
A68	5/24/1994	10.1	5.4	--	--	--	--	--	--	--	--	520	505	--	--	--	--	--	
A68	6/1/1994	24.70	1.40	--	--	--	--	--	--	--	--	490.00	435.00	--	--	--	--	--	
A68	6/8/1994	1.90	<1	--	--	--	--	--	--	--	--	68.00	351.00	--	--	--	--	--	
A68	6/15/1994	6.30	<1	--	--	--	--	--	--	--	--	364.00	361.00	--	--	--	--	--	
A68	6/22/1994	6.90	<1	--	--	--	--	--	--	--	--	315.00	813.00	--	--	--	--	--	
A68	7/13/1994	<1	<1	--	--	--	--	--	--	--	--	351.00	616.00	--	--	--	--	--	
A68	7/20/1994	<1	<1	--	--	--	--	--	--	--	--	363.00	349.00	--	--	--	--	--	
A68	7/27/1994	<1	<1	--	--	--	--	--	--	--	--	379.00	351.00	--	--	--	--	--	
A68	8/10/1994	<1	<1	--	--	--	--	--	--	--	--	382.00	494.00	--	--	--	--	--	
A68	8/24/1994	<1	<1	--	--	--	--	--	--	--	--	418.00	412.00	--	--	--	--	--	
A68	9/15/1994	2.40	<1	--	--	--	--	--	--	--	--	324.00	305.00	--	--	--	--	--	
A68	10/13/1994	<1	<1	--	--	--	--	--	--	--	--	426.00	354.00	--	--	--	--	--	
A68	11/9/1994	<1	<1	--	--	--	--	--	--	--	--	445.00	415.00	--	--	--	--	--	
A68	11/9/1994	ND	<.2	ND	ND	--	--	--	--	--	--	446.00	418.00	2.8	--	104	3.7	--	
A68	12/13/1994	<1	<1	--	--	--	--	--	--	--	--	624.00	665.00	--	--	--	--	--	
A68	1/18/1995	<1	<1	--	--	--	--	--	--	--	--	707.00	689.00	--	--	--	--	--	
A68	2/15/1995	1.20	<1	--	--	--	--	--	--	--	--	874.00	849.00	--	--	--	--	--	
A68	3/1/1995	<1	<1	--	--	--	--	--	--	--	--	1042.00	1036.00	--	--	--	--	--	
A68	3/15/1995	3.3	0	--	--	--	--	--	--	--	--	1137	1086	--	--	--	--	--	
A68	4/6/1995	9.60	0.00	--	--	--	--	--	--	--	--	1100.00	1026.00	--	--	--	--	--	
A68	4/12/1995	7.20	0.00	--	--	--	--	--	--	--	--	1035.00	968.00	--	--	--	--	--	
A68	4/12/1995	5.00	<.2	ND	ND	--	--	ND	ND	ND	ND	1255.00	1090.00	2.6	2.7	136	4	--	
A68	4/19/1995	1.5	0	--	--	--	--	--	--	--	--	1116	--	--	--	--	--	--	
A68	5/3/1995	1.30	<1	--	--	--	--	--	--	--	--	103.00	1072.00	--	--	--	--	--	
A68	5/10/1995	10.8	0	--	--	--	--	--	--	--	--	1303	114	--	--	--	--	--	
A68	5/22/1995	17	1	--	--	--	--	--	--	--	--	908	778	--	--	--	--	--	
A68	5/31/1995	3.80	<1	--	--	--	--	--	--	--	--	873.00	852.00	--	--	--	--	--	
A68	6/7/1995	12.00	1.80	--	--	--	--	--	--	--	--	606.00	526.00	--	--	--	--	--	
A68	6/14/1995	<1	4.60	--	--	--	--	--	--	--	--	744.00	388.00	--	--	--	--	--	
A68	6/21/1995	39.00	<1	--	--	--	--	--	--	--	--	518.00	416.00	--	--	--	--	--	
A68	6/21/1995	166.00	<.2	ND	ND	--	--	ND	ND	ND	ND	720.00	470.00	0.94	--	30	4	--	
A68	6/28/1995	49.30	7.60	--	--	--	--	--	--	--	--	415.00	380.00	--	--	--	--	--	
A68	7/5/1995	7.90	5.50	--	--	--	--	--	--	--	--	482.00	475.00	--	--	--	--	--	
A68	7/12/1995	4.2	0	--	--	--	--	--	--	--	--	386	225	--	--	--	--	--	
A68	7/19/1995	10.30	1.30	--	--	--	--	--	--	--	--	352.00	339.00	--	--	--	--	--	
A68	8/2/1995	2.80	<1	--	--	--	--	--	--	--	--	351.00	338.00	--	--	--	--	--	
A68	8/16/1995	2.40	1.00	--	--	--	--	--	--	--	--	305.00	307.00	--	--	--	--	--	
A68	9/6/1995	16.00	<.2	ND	ND	--	--	ND	ND	ND	ND	380.00	320.00	1.7	--	80	7	--	
A68	9/13/1995	4.6	0	--	--	--	--	--	--	--	--	319	--	--	--	--	--	--	
A68	10/11/1995	3.00	1.30	--	--	--	--	--	--	--	--	378.00	377.00	--	--	--	--	--	
A68	11/15/1995	1.1	0	--	--	--	--	--	--	--	--	485	474	--	--	--	--	--	
A68	11/29/1995	ND	<.2	ND	ND	--	--	ND	ND	ND	ND	325.00	300.00	2.6	--	137	1	--	
A68	12/13/1995	0	0	--	--	--	--	--	--	--	--	537	515	--	--	--	--	--	
A68	2/14/1996	1.90	<1	--	--	--	--	--	--	--	--	578.00	563.00	--	--	--	--	--	
A68	3/13/1996	1.30	<1	--	--	--	--	--	--	--	--	858.00	799.00	--	--	--	--	--	
A68	3/20/1996	8.40	<1	--	--	--	--	--	--	--	--	890.00	847.00	--	--	--	--	--	
A68	4/3/1996	9.80	--	--	--	--	--	--	--	--	--	1141.00	--	--	--	--	--	--	
A68	4/9/1996	15.00	<5	ND	ND	--	--	ND	ND	ND	ND	1100.00	1100.00	2.2	--	130	1	--	
A68	4/10/1996	12.40	<1	--	--	--	--	--	--	--	--	895.00	832.00	--	--	--	--	--	

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Lead	Dissolved Lead	Total Selenium	Dissolved Selenium	Total Strontium	Dissolved Strontium	Total Thallium	Dissolved Thallium	Total Vanadium	Dissolved Vanadium	Total Zinc	Dissolved Zinc	Total Sodium	Dissolved Sodium	Sulfate	Chloride	TSS	TDS
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	<b>0.5</b>	--	--	--	--	--	--	--	--	<b>280</b>	--	--	--	--	--	--	
A68	4/17/1996	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	5/1/1996	16.10	<b>1.30</b>	--	--	--	--	--	--	--	591.00	<b>530.00</b>	--	--	--	--	--	--	
A68	5/8/1996	27.90	<b>1.70</b>	--	--	--	--	--	--	--	499.00	<b>420.00</b>	--	--	--	--	--	--	
A68	5/15/1996	36.10	<1	--	--	--	--	--	--	--	395.00	<b>341.00</b>	--	--	--	--	--	--	
A68	5/21/1996	43.00	<b>2.00</b>	ND	ND	--	--	ND	ND	ND	370.00	<b>350.00</b>	0.8	--	29	ND	--	80	
A68	5/29/1996	2.20	<b>1.00</b>	--	--	--	--	--	--	--	494.00	<b>470.00</b>	--	--	--	--	--	--	
A68	6/5/1996	9.30	<b>3.70</b>	--	--	--	--	--	--	--	301.00	<b>319.00</b>	--	--	--	--	--	--	
A68	6/12/1996	3.60	<1	--	--	--	--	--	--	--	298.00	<b>289.00</b>	--	--	--	--	--	--	
A68	6/19/1996	3.50	<1	--	--	--	--	--	--	--	267.00	244.00	--	--	--	--	--	--	
A68	6/26/1996	2.40	<1	--	--	--	--	--	--	--	281.00	262.00	--	--	--	--	--	--	
A68	7/3/1996	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
A68	7/10/1996	3.60	<1	--	--	--	--	--	--	--	287.00	263.00	--	--	--	--	--	--	
A68	7/16/1996	2.00	<5	ND	ND	--	--	ND	ND	ND	310.00	<b>300.00</b>	1.5	--	63	ND	--	140	
A68	7/17/1996	1.30	<1	--	--	--	--	--	--	--	293.00	<b>291.00</b>	--	--	--	--	--	--	
A68	8/7/1996	<1	<1	--	--	--	--	--	--	--	399.00	<b>392.00</b>	--	--	--	--	--	--	
A68	8/14/1996	ND	<5	ND	ND	--	--	ND	ND	ND	450.00	<b>430.00</b>	1.8	--	100.0	ND	--	190.0	
A68	8/21/1996	1.10	<1	--	--	--	--	--	--	--	449.00	<b>437.00</b>	--	--	--	--	--	--	
A68	9/18/1996	15.50	<1	--	--	--	--	--	--	--	427.00	<b>371.00</b>	--	--	--	--	--	--	
A68	10/1/1996	1.40	0.00	0.00	0.00	--	--	--	--	0	0	431.80	<b>422.70</b>	--	1.93	86.2	1.53	--	
A68	10/1/1996	1.40	0.00	0.00	0.00	--	--	--	--	0	0	431.80	<b>422.70</b>	--	1.93	86.2	1.53	--	
A68	10/16/1996	1.70	<1	--	--	--	--	--	--	--	411.00	<b>285.00</b>	--	--	--	--	--	--	
A68	10/23/1996	--	0.00	0.00	--	--	--	--	--	--	--	<b>494.00</b>	--	--	--	--	--	--	
A68	11/13/1996	<1	<1	--	--	--	--	--	--	--	463.00	<b>477.00</b>	--	--	--	--	--	--	
A68	11/19/1996	<30	<30	0.00	0.00	528.2	523.8	0.0	0.0	<4	<4	564.26	<b>573.65</b>	2.48	2.26	116.0	--	--	--
A68	1/7/1997	<5	<5	<5	<5	--	--	<5	<5	<5	<5	980.00	<b>1000.00</b>	3.4	--	140.0	<1	--	280.0
A68	1/8/1997	<30	<30	0.00	0.00	616.3	566.7	0.0	0.0	<4	<4	805.55	<b>736.76</b>	2.82	2.37	82.6	--	--	--
A68	1/30/1997	<30	<30	0.00	0.00	754.1	700.0	0.0	0.0	<4	<4	1024.87	<b>938.30</b>	3.34	2.86	155.0	--	--	--
A68	2/25/1997	<30	<b>51.70</b>	0.00	0.00	598.9	605.9	0.0	0.0	<4	<4	938.72	<b>860.34</b>	2.41	2.47	141.0	--	--	--
A68	3/5/1997	ND	<5	ND	ND	--	--	ND	ND	ND	1200.00	<b>1300.00</b>	2.9	--	150.0	ND	--	300.0	
A68	3/12/1997	6.90	<1	--	--	--	--	--	--	--	973.00	<b>954.00</b>	--	--	--	--	--	--	
A68	3/19/1997	39.00	<1	--	--	--	--	--	--	--	1399.00	<b>1179.00</b>	--	--	--	--	--	--	
A68	3/25/1997	<30	<30	0.00	0.00	510.9	439.1	0.0	0.0	<4	<4	1543.79	<b>1239.50</b>	2.14	1.93	116.0	--	--	--
A68	4/2/1997	5.20	<1	--	--	--	--	--	--	--	1210.00	<b>1192.00</b>	--	--	--	--	--	--	
A68	4/16/1997	10.90	0.00	--	--	--	--	--	--	--	956.00	<b>937.00</b>	--	--	--	--	--	--	
A68	4/16/1997	14.10	<1	--	--	--	--	--	--	--	1126.00	<b>1035.00</b>	--	--	--	--	--	--	
A68	4/29/1997	<30	<30	0.00	0.00	396.6	402.1	0.0	0.0	<4	<4	928.70	<b>882.15</b>	1.89	1.75	92.0	--	--	--
A68	4/30/1997	7.30	<1	--	--	--	--	--	--	--	937.00	<b>852.00</b>	--	--	--	--	--	--	
A68	5/7/1997	14.00	<5	ND	ND	--	--	ND	ND	ND	700.00	<b>680.00</b>	1.5	--	69	ND	--	130	
A68	5/14/1997	58.99	<30	0.00	0.00	223.7	226.7	0.0	0.0	<4	<4	772.32	<b>596.52</b>	1.12	1.24	45.6	--	--	--
A68	5/21/1997	<30	<30	0.00	0.00	186.1	195.9	0.0	0.0	<4	<4	452.23	<b>392.61</b>	0.91	1.12	39.9	--	--	--
A68	5/21/1997	20.10	<b>10.20</b>	--	--	--	--	--	--	--	478.00	<b>481.00</b>	--	--	--	--	--	--	
A68	5/28/1997	3.40	<1	--	--	--	--	--	--	--	527.00	<b>511.00</b>	--	--	--	--	--	--	
A68	5/29/1997	<30	<30	0.00	0.00	244.8	253.9	0.0	0.0	<4	<4	482.44	<b>482.42</b>	1.14	1.44	51.7	--	--	--
A68	6/4/1997	55.40	<b>1.70</b>	--	--	--	--	--	--	--	548.00	<b>454.00</b>	--	--	--	--	--	--	
A68	6/5/1997	55.28	<30	0.00	0.00	141.9	151.0	0.0	0.0	<4	<4	373.71	266.17	0.68	0.93	27.6	--	--	--
A68	6/11/1997	<30	<30	0.00	0.00	177.5	201.9	0.0	0.0	<4	<4	390.57	<b>418.63</b>	0.					

**Table A-1**

## **Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest**

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Lead	Dissolved Lead	Total Selenium	Dissolved Selenium	Total Strontium	Dissolved Strontium	Total Thallium	Dissolved Thallium	Total Vanadium	Dissolved Vanadium	Total Zinc	Dissolved Zinc	Total Sodium	Dissolved Sodium	Sulfate	Chloride	TSS	TDS
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>	--	<b>0.5</b>	--	--	--	--	--	--	--	--	--	<b>280</b>	--	--	--	--	--	--	
A68	7/9/1998	<30	<30	0.00	0.00	178.6	198.5	0.0	0.0	<4	<4	230.92	227.25	0.854	1.03	37.0	--	--	
A68	7/15/1998	2.10	0.00	--	--	--	--	--	--	--	--	274.00	<b>295.00</b>	--	--	--	--	--	
A68	7/22/1998	<30	<30	0.00	0.00	284.9	278.3	0.0	0.0	<4	<4	260.45	226.21	1.32	1.27	59.0	--	--	
A68	7/22/1998	3.90	0.00	--	--	--	--	--	--	--	--	311.00	<b>298.00</b>	--	--	--	--	--	
A68	8/5/1998	--	<b>5.00</b>	--	--	--	--	--	--	--	--	--	<b>310.00</b>	--	--	63	--	--	
A68	8/26/1998	1.90	0.00	--	--	--	--	--	--	--	--	358.00	<b>342.00</b>	--	--	--	--	--	
A68	9/2/1998	4.70	<b>1.20</b>	--	--	--	--	--	--	--	--	320.00	<b>335.00</b>	--	1.67	73.4	0.81	--	
A68	9/2/1998	4.70	<b>1.20</b>	--	--	--	--	--	--	--	--	320.00	<b>335.00</b>	--	1.67	73.4	0.81	--	
A68	9/9/1998	ND	<1	ND	ND	--	--	ND	ND	ND	ND	390.00	<b>420.00</b>	2.00	--	99.00	ND	--	230.00
A68	9/16/1998	0.00	0.00	--	--	--	--	--	--	--	--	360.00	<b>298.00</b>	--	--	--	--	--	
A68	9/30/1998	<30	<30	0.00	0.00	501.9	499.8	0.0	0.0	<4	<4	362.24	<b>350.99</b>	2.31	2.22	108.0	--	--	--
A68	10/7/1998	--	<5	--	--	--	--	--	--	--	--	--	<b>460.00</b>	--	--	101	--	--	
A68	11/3/1998	3.00	<1	ND	ND	--	--	ND	ND	ND	ND	600.00	<b>660.00</b>	2.2	--	110	2	--	220
A68	11/18/1998	3.20	0.00	--	--	--	--	--	--	--	--	590.00	<b>594.00</b>	--	--	--	--	--	
A68	12/2/1998	--	<5	--	--	--	--	--	--	--	--	--	<b>765.00</b>	--	--	125	--	--	
A68	1/6/1999	2.00	<1	ND	ND	--	--	ND	ND	ND	ND	760.00	<b>860.00</b>	2.40	--	150.00	1.00	--	280.00
A68	1/6/1999	2.00	<1	ND	ND	--	--	ND	ND	ND	ND	760.00	<b>860.00</b>	2.4	--	150	1	--	280
A68	2/4/1999	--	<5	--	--	--	--	--	--	--	--	--	<b>810.00</b>	--	--	176	--	--	
A68	2/17/1999	0.00	<30	0.00	0.00	0.0	620.1	0.0	0.0	0.0	<4	0.00	<b>640.18</b>	--	2.713	--	--	--	
A68	2/24/1999	11.70	<3	--	--	--	--	--	--	--	--	806.00	<b>732.00</b>	--	--	--	--	--	
A68	3/3/1999	4.00	<1	-2.00	-2.00	--	--	ND	ND	ND	ND	920.00	<b>1000.00</b>	2.60	--	150.00	1.00	--	280.00
A68	3/17/1999	2.00	<3	--	--	--	--	--	--	--	--	845.00	<b>798.00</b>	--	--	--	--	--	
A68	4/1/1999	2.90	<3	--	--	--	--	--	--	--	--	697.00	<b>635.00</b>	--	--	--	--	--	
A68	4/7/1999	--	<5	--	--	--	--	--	--	--	--	--	<b>790.00</b>	--	--	133	--	--	
A68	4/26/1999	5.80	<b>1.80</b>	--	--	--	--	--	--	--	--	530.00	<b>485.00</b>	--	--	--	--	--	
A68	4/29/1999	0.00	<30	0.00	0.00	0.0	509.4	0.0	0.0	0.0	<4	0.00	<b>898.94</b>	--	2.406	--	--	--	
A68	5/6/1999	6.00	<1	-2.00	ND	--	--	ND	ND	ND	ND	1800.00	<b>1900.00</b>	2.10	--	120.00	3.00	--	270.00
A68	6/9/1999	--	<5	--	--	--	--	--	--	--	--	--	<b>270.00</b>	--	--	30	--	--	
A68	6/23/1999	21.60	<b>0.60</b>	--	--	--	--	--	--	ND	ND	297.80	224.70	--	0.79	25	ND	--	
A68	6/23/1999	21.60	<b>0.60</b>	--	--	--	--	--	--	ND	ND	297.80	224.70	--	0.79	25	ND	--	
A68	7/7/1999	--	<b>5.00</b>	--	--	--	--	--	--	--	--	--	<b>288.00</b>	--	--	35	--	--	
A68	8/4/1999	3.00	<1	<5	<5	--	--	<5	<5	<5	<5	280.00	<b>290.00</b>	1.2	--	39	<1	--	120
A68	8/4/1999	3.00	<1	<5	<5	--	--	<5	<5	<5	<5	280.00	<b>290.00</b>	1.2	--	39	<1	--	120
A68	8/19/1999	--	<30	--	--	294.429	--	--	--	<4	--	--	<b>296.18</b>	--	1.419	--	--	--	
A68	9/1/1999	3.00	<1	<5	<5	--	--	<1	<1	<5	<5	320.00	<b>310.00</b>	1.5	--	62	2	--	140
A68	9/16/1999	4.10	<b>3.20</b>	2.70	<2	--	--	--	--	--	--	468.20	<b>406.30</b>	--	--	--	--	--	
A68	10/6/1999	--	<5	--	--	--	--	--	--	--	--	--	<b>506.00</b>	--	--	94	--	--	
A68	10/14/1999	8.30	<b>5.60</b>	4.00	2.60	--	--	--	--	--	--	400.60	260.40	--	--	--	--	--	
A68	11/3/1999	2.00	<1	<5	<5	--	--	<1	<1	<5	<5	470.00	<b>720.00</b>	2.2	--	110	<1	--	260
A68	11/17/1999	11.30	<b>9.90</b>	<2	2.90	--	--	--	--	--	--	569.10	<b>564.00</b>	--	--	--	--	--	
A68	12/1/1999	--	<5	--	--	--	--	--	--	--	--	--	<b>697.00</b>	--	--	137	--	--	
A68	1/5/2000	1.00	<1	<5	<5	--	--	<5	<5	<5	<5	630.00	<b>700.00</b>	2.4	--	170	1	--	250
A68	2/2/2000	--	<5	--	--	--	--	--	--	--	--	--	<b>787.00</b>	--	--	158	--	--	
A68	2/28/2000	4.90	<3	2.90	<2	--	--	--	--	--	--	772.00	<b>615.40</b>	--	--	--	--	--	
A68	3/1/2000	2.00	<1	<5	<5	--	--	<1	<1	<5	<5	630.00	<b>710.00</b>	3	--	190	4	--	290
A68	3/15/2000	2.80	<3	2.10	<2	--	--	--	--	--	--	797.10	<b>721.10</b>	--	--	--	--	--	
A68	4/5/2000	--	<5	--	--														

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Lead	Dissolved Lead	Total Selenium	Dissolved Selenium	Total Strontium	Dissolved Strontium	Total Thallium	Dissolved Thallium	Total Vanadium	Dissolved Vanadium	Total Zinc	Dissolved Zinc	Total Sodium	Dissolved Sodium	Sulfate	Chloride	TSS	TDS
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>	--	<b>0.5</b>	--	--	--	--	--	--	--	--	--	<b>280</b>	--	--	--	--	--	--	
A68	9/6/2000	19.00	<1	<5	<5	--	--	<1	<1	<5	<5	540.00	<b>520.00</b>	2.1	--	110	2	--	210
A68	10/4/2000	--	<5	--	--	--	--	--	--	--	--	510.00	--	--	126	--	--	--	
A68	11/1/2000	11.00	<1	<5	<5	--	--	<1	<1	<5	<5	540.00	<b>510.00</b>	2.2	--	120	2	--	230
A68	12/6/2000	--	<5	--	--	--	--	--	--	--	--	648.00	--	--	139	--	--	--	
A68	1/3/2001	2.00	<1	<5	<5	--	--	<1	<1	<5	<5	820.00	<b>780.00</b>	3	--	180	1	--	290
A68	2/7/2001	--	<5	--	--	--	--	--	--	--	--	680.00	--	--	147	--	--	--	
A68	3/14/2001	4.00	<1	<5	<5	--	--	<1	<1	<50	<5	710.00	<b>780.00</b>	--	2.9	150	1	--	280
A68	4/4/2001	--	<5	--	--	--	--	--	--	--	--	1070.00	--	--	146	--	--	--	
A68	5/2/2001	32.00	<b>2.00</b>	<5	<5	--	--	<1	<1	<5	<5	710.00	<b>630.00</b>	1.4	--	51	2	--	110
A68	6/6/2001	--	<5	--	--	--	--	--	--	--	--	310.00	--	--	32	--	--	--	
A68	7/6/2001	3.00	<1	<5	<5	--	--	<1	<1	<.005	<.005	250.00	250.00	1	--	45	<1	--	110
A68	8/1/2001	--	<5	--	--	--	--	--	--	--	--	346.00	--	--	73	--	--	--	
A68	10/3/2001	--	<5	--	--	--	--	--	--	--	--	506.00	--	--	131	--	--	--	
A68	12/5/2001	--	<5	--	--	--	--	--	--	--	--	750.00	--	--	184	--	--	--	
A68	1/2/2002	2.20	<1	<3	<3	--	--	<.001	<.001	<3	<3	830.00	<b>890.00</b>	3.2	--	230	1.4	--	330
A68	3/6/2002	22.00	<1	<3	<3	--	--	<1	<1	<50	<5	610.00	<b>600.00</b>	3.1	--	150	1.4	--	260
A68	4/3/2002	--	<5	--	--	--	--	--	--	--	--	510.00	--	--	121	--	--	--	
A68	5/1/2002	--	<5	--	--	--	--	--	--	--	--	422.00	--	--	66	--	--	--	
A68	6/5/2002	0.20	<1	<1	<1	--	--	--	--	<5	--	261.00	255.00	--	0.9	54.7	0.7	--	122
A68	6/27/2002	<3	<3	<2	<2	--	--	--	--	--	--	293.10	278.90	--	--	--	--	--	--
A68	7/3/2002	<5	<5	<2	<2	--	--	--	--	--	--	357.00	<b>340.00</b>	--	2.54	105	0.47	--	161
A68	7/17/2002	3.70	<3	2.60	<2	--	--	--	--	--	--	328.10	<b>314.60</b>	--	--	--	--	--	--
A68	8/7/2002	--	<5	--	--	--	--	--	--	--	--	496.00	--	--	118	--	--	--	
A68	8/14/2002	<3	<3	<2	<2	--	--	--	--	--	--	435.40	<b>413.40</b>	--	--	--	--	--	--
A68	9/4/2002	2.00	<1	<1	1.00	--	--	<1	<1	<1	<1	545.00	<b>558.00</b>	--	2.4	132	<1	--	240
A68	9/18/2002	<3	<3	<2	<2	--	--	--	--	--	--	440.50	<b>416.60</b>	--	--	--	--	--	--
A68	10/2/2002	--	<5	--	--	--	--	--	--	--	--	648.00	--	--	112	--	--	--	
A68	10/25/2002	<3	<3	2.70	2.70	--	--	--	--	--	--	634.20	<b>615.80</b>	--	--	--	--	--	--
A68	11/6/2002	3.00	<1	<1	<1	--	--	<1	<1	<1	<1	646.00	<b>641.00</b>	3.6	--	136	<1	--	234
A68	11/12/2002	2.00	<3	2.60	3.80	--	--	--	--	--	--	620.20	<b>593.90</b>	--	--	--	--	--	--
A68	12/4/2002	--	<5	--	--	--	--	--	--	--	--	877.00	--	--	157	--	--	--	
A68	12/8/2002	2.30	<3	3.90	<2	--	--	--	--	--	--	820.10	<b>778.10</b>	--	--	--	--	--	--
A68	1/8/2003	3.70	<3	3.10	<2	--	--	--	--	--	--	863.20	<b>831.70</b>	--	--	--	--	--	--
A68	1/9/2003	3.00	<1	<1	<1	--	--	<1	<1	<1	<1	743.00	<b>718.00</b>	<1	--	154	<1	--	259
A68	2/1/2003	<3	<b>2.40</b>	6.40	<2	--	--	--	--	--	--	681.90	<b>672.00</b>	--	--	--	--	--	--
A68	2/5/2003	--	<5	--	--	--	--	--	--	--	--	--	<b>850.00</b>	--	--	175	--	--	--
A68	3/9/2003	6.60	<3	2.10	<2	--	--	--	--	--	--	692.70	<b>708.80</b>	--	--	--	--	--	--
A68	4/24/2003	2.30	<3	<2	<2	--	--	--	--	--	--	698.00	<b>657.30</b>	--	--	--	--	--	--
A68	5/7/2003	<3	<3	<2	<2	--	--	--	--	--	--	549.40	<b>518.50</b>	--	--	--	--	--	--
A68	5/7/2003	3.91	<1	<2.5	<2.5	--	--	<1	<1	<1	<1	594.50	<b>552.50</b>	2.72	--	76.1	17.1	--	168.76
A68	6/2/2003	28.5	0	0	0	--	--	--	--	--	--	442.1	0	--	--	--	--	--	--
A68	7/2/2003	<3	<3	7.00	<2	--	--	--	--	--	--	338.60	<b>289.90</b>	--	--	--	--	--	--
A68	7/2/2003	2.21	<1	0.73	0.66	--	--	<1	<1	<1	<1	302.70	<b>318.10</b>	<1	--	57.4	3.18	--	123.33
A68	8/14/2003	33.70	<3	2.10	2.30	--	--	--	--	--	--	397.50	<b>319.50</b>	--	--	--	--	--	--
A68	9/11/2003	5.20	<3	4.30	<2	--	--	--	--	--	--	626.90	<b>545.60</b>	--	--	--	--	--	--
A68	9/11/2003	7.00	--	<.5	--	--	--	<1	--	<1	--	620.00	<b>546.00</b>	--	--	--	<1	--	171
A68	10/4/2003	2.70	<3	<2	<2	--	--	--	--	--	--	393.00	<b>375.</b>						

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Lead	Dissolved Lead	Total Selenium	Dissolved Selenium	Total Strontium	Dissolved Strontium	Total Thallium	Dissolved Thallium	Total Vanadium	Dissolved Vanadium	Total Zinc	Dissolved Zinc	Total Sodium	Dissolved Sodium	Sulfate	Chloride	TSS	TDS
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>		--	<b>0.5</b>	--	--	--	--	--	--	--	--	<b>280</b>	--	--	--	--	--	--	
A68	4/16/2004	13.90	<3	7.00	<2	--	--	--	--	--	--	1106.80	<b>1074.00</b>	--	--	--	--	--	
A68	5/5/2004	7.40	<3	14.80	<2	--	--	--	--	--	--	671.00	<b>572.80</b>	--	--	--	--	--	
A68	5/5/2004	12.00	<b>2.00</b>	0.90	<.5	--	--	<1	<1	<1	<1	960.00	<b>580.00</b>	1.5	--	65	3.2	--	122
A68	5/28/2004	6.70	<b>3.30</b>	<2	<2	--	--	--	--	--	--	348.40	209.60	--	--	--	--	--	--
A68	6/17/2004	3.00	<3	6.50	6.40	--	--	--	--	--	--	375.60	<b>353.60</b>	--	--	--	--	--	--
A68	7/7/2004	3.00	<1	<1	<1	--	--	<1	<1	1	<1	326.00	<b>295.00</b>	1.1	--	62.2	<1	--	134
A68	7/7/2004	6.5	<3	8.1	0	--	--	--	--	--	--	336.1	<b>331.9</b>	--	--	--	--	--	--
A68	8/19/2004	<3	<3	6.70	<2	--	--	--	--	--	--	555.00	<b>431.90</b>	--	--	--	--	--	--
A68	9/1/2004	2.00	<1	6.00	<6	--	--	<1	<1	<100	<1	672.00	<b>512.00</b>	3	--	135	<1	--	221
A68	9/15/2004	0	<3	18.6	18.1	--	--	--	--	--	--	548.5	<b>510.7</b>	--	--	--	--	--	--
A68	10/14/2004	6.50	<3	8.10	<2	--	--	--	--	--	--	336.10	<b>331.90</b>	--	--	--	--	--	--
A68	11/10/2004	2.00	<b>1.00</b>	0.50	0.50	--	--	1	1	1	1	622.00	<b>588.00</b>	--	3	--	1	--	203
A68	11/10/2004	<3	<3	4.90	7.40	--	--	--	--	--	--	650.10	<b>645.30</b>	--	--	--	--	--	--
A68	12/8/2004	<3	<3	4.50	3.10	--	--	--	--	--	--	703.10	<b>675.50</b>	--	--	--	--	--	--
A68	1/20/2005	3.59	<3	<2	<2	--	--	--	--	--	--	689.33	<b>679.29</b>	--	--	--	--	--	--
A68	2/15/2005	4.56	<3	6.01	3.73	--	--	--	--	--	--	966.42	<b>944.98</b>	--	--	--	--	--	--
A68	03/02/2005	4	<1	0.7	1	--	--	<1	<1	<100	<1	1120	<b>1120</b>	--	3	--	<1	--	284
A68	3/13/2005	3.29	<3	3.66	<2	--	--	--	--	--	--	1099.18	<b>1056.70</b>	--	--	--	--	--	--
A68	4/9/2005	7.50	<3	4.13	<2	--	--	--	--	--	--	1103.82	<b>1043.59</b>	--	--	--	--	--	--
A68	5/4/2005	3.38	<3	2.80	<2	--	--	--	--	--	--	1048.03	<b>1007.38</b>	--	--	--	--	--	--
A68	05/04/2005	4	<1	<.5	4.2	--	--	<1	<1	<100	<1	1070	<b>1030</b>	--	3	--	7	--	211
A68	6/9/2005	7	<3	0	0	--	--	--	--	--	--	405.1	<b>380</b>	--	--	--	--	--	--
A68	7/6/2005	0	<3	0	5	--	--	--	--	--	--	306.3	<b>285.8</b>	--	--	--	--	--	--
A68	07/06/2005	4	<1	<.5	<.5	--	--	<1	<1	<100	<1	293	<b>312</b>	--	1	--	<1	--	82
A68	8/10/2005	<3	<3	<2	<2	--	--	--	--	--	--	257.8	265.1	--	--	--	--	--	--
A68	9/14/2005	<3	<3	<2	<2	--	--	--	--	--	--	453.6	<b>446.4</b>	--	--	--	--	--	--
A68	9/15/2005	2	<1	0.6	<.5	--	--	<1	<1	<100	<1	447	<b>428</b>	--	2	--	<1	--	204
A68	10/13/2005	1.2	<3	<2	<2	--	--	--	--	--	--	447.7	<b>416.8</b>	--	--	--	--	--	--
A68	11/2/2005	<3	<3	<2	<2	--	--	--	--	--	--	537	<b>499.6</b>	--	--	--	--	--	--
A68	11/2/2005	2	<1	<.5	0.5	--	--	<1	<1	<100	<1	535	<b>552</b>	--	2	--	<1	--	190
A68	12/20/2005	<3	<3	<2	5.2	--	--	--	--	--	--	691.1	<b>658.1</b>	--	--	--	--	--	--
A68	1/6/2006	<3	<3	<2	<2	--	--	--	--	--	--	744.1	<b>734.5</b>	--	--	--	--	--	--
A68	01/06/2006	2	<1	0.6	0.9	--	--	--	--	<100	<1	756	<b>772</b>	--	3	160	<1	--	241
A68	2/8/2006	<3	<3	7.2	3.8	--	--	--	--	--	--	1020.2	<b>1015.2</b>	--	--	--	--	--	--
A68	3/15/2006	<3	<3	2.6	<2	--	--	--	--	--	--	920.8	<b>893.4</b>	--	--	--	--	--	--
A68	03/15/2006	2	<1	<.5	<.5	--	--	--	--	<100	<1	972	<b>955</b>	--	3	169	<1	--	278
A68	4/5/2006	6.7	<3	5.3	2.7	--	--	--	--	--	--	1213.5	<b>1171.5</b>	--	--	--	--	--	--
A68	5/10/2006	5	<3	<2	<2	--	--	--	--	--	--	520.7	<b>490.2</b>	--	--	--	--	--	--
A68	05/10/2006	3	<1	<.5	<.5	--	--	--	--	<100	<1	521	<b>495</b>	--	1	66	<1	--	136
A68	05/16/2006	--	<1	--	<.5	--	--	--	--	--	<1	--	<b>301</b>	--	<1	40	<1	--	97
A68	6/6/2006	17.2	<3	4.1	<2	--	--	--	--	--	--	326.1	<b>292.2</b>	--	--	--	--	--	--
A68	7/12/2006	<3	<3	4.4	6.6	--	--	--	--	--	--	340.6	<b>326</b>	--	--	--	--	--	--
A68	07/12/2006	2	<1	<.5	<.5	--	--	--	--	<100	<1	355	<b>336</b>	--	1	65	<1	--	150
A68	8/2/2006	4.1	<3	<2	<2	--	--	--	--	--	--	370.1	<b>360.1</b>	--	--	--	--	--	--
A68	9/6/2006	3.7	<3	<2	<2	--	--	--	--	--	--	599.7	<b>390.5</b>	--	--	--	--	--	--
A68	09/06/2006	2	<1	0.9	0.7	--	--	--	--	<100	<1	474	<b>455</b>	--	2	101	<1	--	178

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Lead	Dissolved Lead	Total Selenium	Dissolved Selenium	Total Strontium	Dissolved Strontium	Total Thallium	Dissolved Thallium	Total Vanadium	Dissolved Vanadium	Total Zinc	Dissolved Zinc	Total Sodium	Dissolved Sodium	Sulfate	Chloride	TSS	TDS
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>	--	<b>0.5</b>	--	--	--	--	--	--	--	--	--	<b>280</b>	--	--	--	--	--	--	
A68	2/6/2007	<3	<3	<2	<2	--	--	--	--	--	--	838.9	<b>670.9</b>	--	--	--	--	--	
A68	3/7/2007	<3	<3	6.4	3.1	--	--	--	--	--	--	732.9	<b>707.6</b>	--	--	--	--	--	
A68	03/07/2007	2	<1	<.5	<30	--	--	--	--	<100	<1	769	<b>762</b>	--	3	159	<1	--	
A68	4/2/2007	<3	<3	4.1	8.2	--	--	--	--	--	--	698.1	<b>665.8</b>	--	--	--	--	--	
A68	05/11/2007	6	<1	<.5	<.5	--	--	--	--	<100	<1	412	<b>355</b>	--	<1	46	<1	--	
A68	5/11/2007	4.3	<b>4.5</b>	13.3	0	--	--	--	--	--	--	380.5	<b>357.3</b>	900	916	--	--	--	
A68	6/5/2007	11.9	<3	0	0	--	--	--	--	--	--	298.7	254.8	671	591	--	--	--	
A68	6/14/2007	3.4	<1	--	--	--	--	--	--	--	--	256	254	--	925	0.037	<.5	--	
A68	6/14/2007	3.4	<1	--	--	--	--	--	--	--	--	256	254	--	925	0.037	<.5	--	
A68	7/11/2007	3.4	<b>3.4</b>	0	0	--	--	--	--	--	--	269.2	249.7	1074	980	--	--	--	
A68	07/11/2007	2	<1	<.5	<.5	--	--	--	--	<100	<1	288	<b>284</b>	--	2	61	<1	--	
A68	8/6/2007	55.8	<3	48.4	53.9	--	--	--	--	--	--	300.1	218.9	1182	1086	--	--	--	
A68	9/5/2007	7.4	<3	12.3	11.7	--	--	--	--	--	--	347.4	<b>309.5</b>	2238	2100	--	--	--	
A68	09/05/2007	<5	<5	<.5	<1	--	--	--	--	<100	<100	360	<b>350</b>	--	2.5	103	<1	--	
A68	10/25/2007	7.8	<b>3.5</b>	--	--	--	--	--	--	--	--	418.5	<b>396.1</b>	--	--	--	--	--	
A68	11/07/2007	2	<1	<.5	0.6	--	--	--	--	<100	<1	509	<b>498</b>	--	2	108	<1	--	
A68	12/5/2007	4.8	<3	0	0	--	--	--	--	--	--	611.3	<b>601.6</b>	2247	2205	--	--	--	
A68	1/2/2008	<1	<1	0.60	0.60	--	--	<1	--	<1	<1	701.00	<b>680.00</b>	--	3	150	<1	--	
A68	1/2/2008	0	<3	92.7	0	--	--	--	--	--	--	1082.8	<b>819.6</b>	5807	2919	--	--	--	
A68	3/12/2008	2.00	<1	<.5	0.50	--	--	<1	--	<1	<1	1330.00	<b>1250.00</b>	--	3	164	<1	--	
A68	4/10/2008	5.3	<3	0	0	--	--	--	--	--	--	1728.1	<b>1622.2</b>	2712	2670	--	--	--	
A68	5/7/2008	7.1	<3	0	0	--	--	--	--	--	--	532.6	<b>487.6</b>	1358	1362	--	--	--	
A68	5/7/2008	6.00	<1	<.5	<.5	--	--	<1	<1	<100	<1	661.00	<b>585.00</b>	--	2	69	<1	--	
A68	6/3/2008	42.7	<b>4</b>	0	0	--	--	--	--	--	--	339.2	220.7	766	629	--	--	--	
A68	7/9/2008	3.7	<3	0	0	--	--	--	--	--	--	276	261.8	685	572	--	--	--	
A68	7/9/2008	3.00	<1	2.00	<.5	--	--	<1	<1	<100	<1	296.00	<b>282.00</b>	--	<1	44	<1	--	
A68	8/5/2008	4.8	<b>3.3</b>	0	0	--	--	--	--	--	--	267.4	249	1027	970	--	--	--	
A68	9/3/2008	6.3	<b>4.3</b>	0	0	--	--	--	--	--	--	365.4	<b>354.9</b>	1449	1418	--	--	--	
A68	9/3/2008	3	<1	<.5	<.6	--	--	<1	<1	<100	<1	429	<b>408</b>	--	2	100	<1	--	
A68	10/6/2008	6.5	<b>4.6</b>	0	0	--	--	--	--	--	--	425.1	<b>403.9</b>	1879	1756	--	--	--	
A68	11/7/2008	5.7	<b>4.6</b>	0	0	--	--	--	--	--	--	672.6	<b>656.8</b>	2496	2238	--	--	--	
A68	11/7/2008	2.00	<b>1.00</b>	<.5	<.6	--	--	<1	<1	<1	<1	748.00	<b>731.00</b>	--	3	--	<1	--	
A68	12/3/2008	6.4	<b>4.7</b>	0	0	--	--	--	--	--	--	556.7	<b>545.8</b>	2225	2317	--	--	--	
A68	3/4/2009	6.9	<b>4.6</b>	0	0	--	--	--	--	--	--	841	<b>784.5</b>	2783	2628	--	--	--	
A68	3/4/2009	2	<1	0.9	0.5	--	--	<1	<1	<100	<1	884	<b>894</b>	--	--	161	<1	--	
A68	4/6/2009	9.7	<b>3.7</b>	0	0	--	--	--	--	--	--	659.1	<b>615.5</b>	2307	2330	--	--	--	
A68	5/13/2009	120	<1	0.8	<.5	--	--	<1	<1	<100	<1	520	219	--	<1	33	<1	--	
A68	5/13/2009	75.8	<b>3.3</b>	0	0	--	--	--	--	--	--	418.4	244.9	837	779	--	--	--	
A68	5/19/2009	52.3	<1.0	<1.0	<1.0	--	--	--	--	--	--	405	<b>295</b>	--	0.912	29.4	0.5	--	
A68	6/2/2009	5.2	<b>3</b>	0	0	--	--	--	--	--	--	328.2	<b>317.4</b>	676	630	--	--	--	
A68	6/16/2009	2.5	<1.0	<1.0	<1.0	--	--	--	--	--	--	324	270	--	1.3	45.5	0.5	--	
A68	7/8/2009	0	<3	0	0	--	--	--	--	--	--	250.8	247.8	1037	1125	--	--	--	
A68	7/8/2009	--	<3	<3	<5	<5	<5	--	--	--	--	250.8	--	1.0	0.5	1.1	--	--	
A68	7/8/2009	2	<1	<.8	<1	--	--	<1	<1	<100	<1	288	274	--	<1	46	<1	--	
A68	7/14/2009	2.1	<1.0	<1.0	<1.0	--	--	--	--	--	--	270	268	--	1.43	58.6	0.5	--	
A68	8/12/2009	0	<3	0	0	--	--	--	--	--	--	283.4	276.4	1708	1601	--	--	--	
A68	8/18/2009	1.4	<1.0	<1.0	<1.0	<1.0	--	--	--	--	--	333	<b>332</b>	--	1.83	107	0.7	--	
A68	9/16/2009																		

Table A-1

## Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest

Sample Location ID	DATE	Total Lead	Dissolved Lead	Total Selenium	Dissolved Selenium	Total Strontium	Dissolved Strontium	Total Thallium	Dissolved Thallium	Total Vanadium	Dissolved Vanadium	Total Zinc	Dissolved Zinc	Total Sodium	Dissolved Sodium	Sulfate	Chloride	TSS	TDS
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	
<b>CDPHE Water Quality Standard<sup>1</sup></b>	--	<b>0.5</b>	--	--	--	--	--	--	--	--	--	<b>280</b>	--	--	--	--	--	--	
A68	11/4/2009	1.00	<1	<.5	0.90	--	--	<1	<1	<100	<1	487.00	<b>470.00</b>	--	2	132	<1	--	219
A68	11/5/2009	0	<3	0	0	--	--	--	--	--	--	114.7	0	19155	3113	--	--	--	--
A68	11/17/2009	1.9	<1.0	<1.0	<1.0	--	--	--	--	--	--	581	<b>567</b>	--	2.87	141	<0.5	<20	250
A68	12/1/2009	3.7	<3	0	0	--	--	--	--	--	--	508.1	<b>488.5</b>	2075	2070	--	--	--	--
A68	2/17/2010	2.7	<1.0	<1.0	<1.0	--	--	--	--	--	--	663	<b>702</b>	--	3.3	167	0.6	300	<20
A68	3/2/2010	4.1	<3	0	0	--	--	--	--	--	--	579.5	<b>530.4</b>	2502	2360	--	--	--	--
A68	3/17/2010	2.4	<1.0	1.6	<1.0	--	--	--	--	--	--	597	<b>610</b>	--	3.4	153	0.9	270	<20
A68	4/16/2010	3.6	<3	0	0	--	--	--	--	--	--	1001.2	<b>933.7</b>	2759	2623	--	--	--	--
A68	5/5/2010	3.8	<3	0	0	--	--	--	--	--	--	464	<b>441.5</b>	1526	1463	--	--	--	--
A68	5/5/2010	3	1.00	<.7	0.70	--	--	<1	<1	<100	<1	458.00	<b>444.00</b>	--	2	70	<1	--	143
A68	6/2/2010	13.3	<3	0	0	--	--	--	--	--	--	296.8	263.7	716	732	--	--	--	--
A68	6/2/2010	15.3	<1.0	<1.0	<1.0	--	--	--	--	--	--	318	<b>286</b>	--	1.3	32.5	<0.5	81	<20
A68	7/8/2010	5.4	4.2	0	0	--	--	--	--	--	--	270.1	265.3	1418	1208	--	--	--	--
A68	7/8/2010	2.00	<1	<.6	<.5	--	--	<1	<1	<100	<1	310.00	<b>283</b>	--	2	67	<1	--	120
A68	7/13/2010	1.5	<1.0	<1.0	<1.0	--	--	--	--	--	--	273	261	--	1.7	70.6	0.42	150	<20
A68	8/10/2010	3.4	<3	0	0	--	--	--	--	--	--	346.8	<b>303.7</b>	1259	1140	--	--	--	--
A68	9/9/2010	0	<3	0	0	--	--	--	--	--	--	342.4	<b>318.5</b>	1812	1797	--	--	--	--
A68	9/9/2010	3.00	<1	<.6	<.5	--	--	<1	<1	<100	<1	366.00	<b>344</b>	--	2	100	<1	--	213
A68	9/14/2010	2.2	<1.0	<1.0	<1.0	--	--	--	--	--	--	380	<b>410</b>	--	2.3	101	0.5	330	<20
A68	10/4/2010	0	<3	0	0	--	--	--	--	--	--	359	<b>337.1</b>	1914	1740	--	--	--	--
A68	11/2/2010	1.7	<1.0	<1.0	<1.0	--	--	--	--	--	--	441	<b>436</b>	--	2.8	109	0.7	210	<20
A68	11/3/2010	<1	2.00	<.5	<.5	--	--	<1	<1	<100	<1	384.00	<b>348</b>	--	2	108	<1	--	173
A68	11/3/2010	0	<3	0	0	--	--	--	--	--	--	371.6	<b>354.8</b>	2025	2077	--	--	--	--
A68	12/7/2010	0	<3	0	0	--	--	--	--	--	--	408.6	<b>386.8</b>	2308	2309	--	--	--	--
A68	1/5/2011	<3	<3	<5	<5	--	--	--	--	--	--	510.1	<b>494.3</b>	2.9	2.6	--	--	--	--
A68	1/5/2011	<1	<1	0.80	0.90	--	--	1	<1	<100	<1	530.00	<b>530</b>	--	3	144	1	264	184
A68	2/11/2011	3.9	<3	<5	<5	--	--	--	--	--	--	720.8	<b>689.4</b>	1.9	1.9	--	--	--	--
A68	3/9/2011	<3	<3	<5	<5	--	--	--	--	--	--	748.1	<b>716.9</b>	2.3	2.3	--	--	--	--
A68	3/9/2011	4	<1	0.8	0.5	--	--	<1	<1	<100	<1	814	<b>799</b>	--	3	167	1	--	265
A68	3/15/2011	5.4	<1.0	<1.0	<1.0	--	--	--	--	--	--	874	<b>874</b>	--	3.34	129	1.3	<20	260
A68	4/6/2011	6.5	<3	<5	<5	--	--	--	--	--	--	1034.9	<b>949.6</b>	1.5	1.5	--	--	--	--
A68	5/4/2011	4	<1	0.5	<.5	--	--	<1	<1	<100	<1	916	<b>916</b>	--	2	126	2	--	211
A68	5/8/2011	13.4	<3	<5	<5	--	--	--	--	--	--	612.6	<b>544.5</b>	0.4	0.4	--	--	--	--
A68	6/3/2011	10.9	<3	<5	<5	--	--	--	--	--	--	345.4	<b>290.4</b>	0.5	0.4	--	--	--	--
A68	6/14/2011	19.6	<1.0	<1.0	<1.0	--	--	--	--	--	--	307	274	--	1.01	31.1	<0.5	<20	79
A68	7/5/2011	4.1	<3	<5	<5	--	--	--	--	--	--	229	211	<.1	<.1	--	--	--	--
A68	7/19/2011	4.9	<1.0	<1.0	<1.0	--	--	--	--	--	--	252	237	--	0.943	39	<0.5	<20	94
A68	8/1/2011	<3	<3	<5	<5	--	--	--	--	--	--	232	221.1	0.3	0.3	--	--	--	--
A68	8/16/2011	1.7	<1.0	<1.0	<1.0	--	--	--	--	--	--	290	<b>282</b>	--	1.83	75.4	<0.5	<20	190
A68	9/7/2011	<3	<3	<5	<5	--	--	--	--	--	--	245.2	236	0.4	0.4	--	--	--	--
A68	9/7/2011	2	<1	<.5	<.5	--	--	<1	<1	<100	<1	317	<b>311</b>	--	2	102	<1	--	203
A68	9/13/2011	1.7	<1.0	<1.0	<1.0	--	--	--	--	--	--	317	<b>311</b>	--	2.39	105	<0.5	<20	200
A68	10/7/2011	<3	<3	<5	<5	--	--	--	--	--	--	414	<b>386.4</b>	0.5	0.4	--	--	--	--
A68	10/18/2011	1.7	<1.0	<1.0	<1.0	--	--	--	--	--	--	399	<b>393</b>	--	2.34	103	0.6	<20	190
A68	11/2/2011	<3	<3	<5	<5	--	--	--											

**Table A-1**

**Animas River Stakeholder Group Surface Water Sample Results - Chemicals of Interest**

Notes:

1. Colorado Department of Public Health and Environment (CDPHE), 2014. Standards are stated as dissolved phase (e.g., filtered with a 0.45 micron filter).

If there is more than one dissolved phase standard then the lowest standard was used, excluding calculated hardness based table value standards.

2. -- = not applicable / not available

3. **BOLD** Concentration exceeded noted Colorado Water Quality Standard

8. mg/L = milligrams per liter

9. µg/L = micrograms per liter

10. < 0.01 = concentration below laboratory reporting limit

11. Source - <http://www.animasriverstakeholdersgroup.org/page11.html>

## **Appendix B – QAPP**

# **Surface Water Investigation Mayflower Mill and Tailings Impoundments Area - Quality Assurance Project Plan (QAPP)**

**May 2015**

Prepared for:

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## **LIST OF ACRONYMS**

CCB	Continuing Calibration Blank
CCV	Continuing Calibration Verification
CLP	EPA Contract Laboratory Program
COC	Chain of Custody
CVAFS	Cold Vapor Atomic Fluorescence Spectroscopy
DO	Dissolved Oxygen
DQOs	Data Quality Objectives
EDD	Electronic Data Deliverable
HASP	Health and Safety Plan
ICB	Initial Calibration Blank
ICP	Inductively Coupled Plasma
ICPMS	Inductively Coupled Plasma-Mass Spectrometer
ICV	Initial Calibration Verification
LCS	Laboratory Control Sample
LFB	Laboratory Fortified Blank
MDL	Method Detection Limit
mg/L	milligrams per liter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ND	Not Detected
NFG	National Functional Guidelines
ORP	Oxidation-Reduction Potential
PQV	Practical Quantitation Verification
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RL	Reporting Limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedures
SRM	Standard Reference Material
EPA	United States Environmental Protection Agency

## **1.0 INTRODUCTION**

This Quality Assurance Project Plan (QAPP) comprises Appendix B of the draft High-Flow Surface Water Investigation Work Plan for the Mayflower Mill and Tailings Impoundments Area (Work Plan). The Work Plan is a precursor to a more extensive hydrogeologic investigation work plan that will be prepared in the near future. The purpose of this QAPP is to describe the quality assurance and quality control (QA/QC) policies and procedures that will be used during data collection and evaluation conducted in support of the surface water investigation proposed to investigate the water quality in the Animas River in the area adjacent to the Mayflower Mill and Tailings Impoundments Area near Silverton, Colorado. There are four tailings impoundments which are associated with the Mayflower milling operation and the former Sunnyside Mine. The tailings impoundments are located approximately one mile to the northeast and upstream of Silverton on the right bank of the Animas River.

The QAPP describes the measures that shall be employed during the surface water investigation to assure that data generated are of a known and defensible quality in relation to the overall objectives of the investigation. These measures will assure that the precision and accuracy of program data are known and documented; sample collection, analysis, and reporting are complete; and samples are representative of tested environmental media. This plan also provides guidance for documentation of information collected in the field, including field quality control data; maintenance of documented sample custody and laboratory analytical procedures; and quality control data for data verification and validation.

The QAPP was prepared in accordance with EPA guidance on Quality Assurance Project Plans (EPA, 2002; EPA QA/G-5) and EPA Requirements for Quality Assurance Project Plans (EPA, 2001; EPA AQ/R-5). It is comprised of the following four basic project plan elements:

- project management;
- data generation and acquisition;
- data review, validation, and usability; and
- data assessment and oversight.

The subsections that follow provide the four EPA project plan elements (EPA, 2002), and each presents the topics applicable to that element with appropriate Site-specific content, as needed for planning the surface water investigation.

## **2.0 PROJECT MANAGEMENT**

This section addresses project administrative functions and project concerns, goals, and approaches to be followed during implementation of the surface water investigation.

### **2.1 Problem Definition and Background**

Previous investigations in the study area have identified elevated levels of metals in the upper Animas River, some of which are above Colorado water quality standards. The current sources of metal loads and their effects on river water quality remain uncertain. Therefore, collection of additional surface water data is needed to identify those sources, where possible. Specifically, additional data are needed to better understand the relationship, if any, between the Mayflower Mill and Tailings Impoundments Area and metals concentrations in the surface water of the upper Animas River adjacent to and downstream from this area.

### **2.2 Project Description**

The Work Plan presents the rationale and scope of data collection and monitoring activities planned to achieve the investigation objective described above. The data collection activities associated with the surface water investigation are described in detail in Section 5.0 of the Work Plan.

### **2.3 Project Organization**

The surface water investigation is being conducted by Sunnyside Gold Corporation (Sunnyside).

Sunnyside's responsibilities include preparation of project planning documents, collection of data needed to complete the surface water investigation and data analysis and interpretation as needed to complete the investigation.

Sunnyside's project team for the surface water investigation includes:

- Formation Environmental LLC (Formation), Boulder, CO (environmental services contractor); and
- ACZ Laboratories (ACZ), Steamboat Springs, CO (analytical laboratory contractor).

**Sunnyside Program Manager** (Pat Maley, Sunnyside Gold Corporation [SGC]).

Oversees scheduling and management of all technical and non-technical aspects of the project (e.g., field activities, data collection, data analysis, report preparation, scheduling, costing) and serves as primary point of contact with agency representatives.

**Sunnyside Technical Lead** (Linda Schmoll, Ph.D., SGC).

Reports to Sunnyside's Program Manager and reviews all technical aspects of the project, including work plans, QAPPs, data analyses, data reports, etc.

**Sunnyside Field Representative** (Terry Turner).

Reports to Sunnyside's Program Manager and oversees all field aspects of the project, including sample collection, measurements, and data collection.

**Formation Project Manager** (Brian Hansen, P.E., Formation)

Oversees scheduling and management of all technical and non-technical aspects of the project (e.g., field activities, data collection, data analysis, report preparation, scheduling, costing) and reports to the Sunnyside Program Manager. Directs the Field Investigations Manager and Project QA Manager. Ensures that all field personnel understand the scope of work including QA/QC requirements. Responsible for ensuring that the sampling methods and data analyses reflected in the Sampling and Analysis Plan (SAP) meet the objectives of the Work Plan. Reviews and approves project plans and all project deliverables.

**Field Investigations Manager** (Nat Beal, P.G., Formation)

Plans and supervises sampling and other field activities and coordinates acquisition of any necessary permits. Schedules and manages various field tasks (e.g., sample collection, measurements, data collection) and is responsible for sample transport to the laboratory. Responsible to the Sunnyside and Formation Project Managers for implementation of field sampling activities, QA/QC measures, and health and safety program requirements defined in the Appendix D of the Work Plan. The Field Investigations Manager is also responsible for ensuring that field staff have appropriate, hands-on training and properly utilize the project Standard Operating Procedures (SOPs; Appendix C of the Work Plan).

**Project QA Manager** (Peg Seracuse, Formation)

Responsible for coordinating the development and approval of the QAPP and its supporting procedures and for maintaining the current, approved version of the QAPP for use on the project. The QA Manager participates in the review and approval of all project deliverables,

assists with establishing laboratory contracts, acts as a day-to-day liaison with the laboratories, directs field and laboratory audit activities, coordinates any subsequent corrective and preventive actions, if needed, and communicates regularly with the Formation Project Manager and Field Investigations Manager regarding any laboratory or data validation concerns. The QA Manager will also oversee data validation efforts and coordinate the resolution of any necessary corrective actions resulting from data validation activities, including any quality issues that may be resolved during field activities (i.e., resampling to replace unusable samples).

**ACZ Project Manager (Max Janicek, ACZ)**

Reviews QAPP and ensures laboratory resources are available, reviews final analytical reports produced by the laboratory, coordinates scheduling of laboratory analyses, and supervises in-house chain-of-custody procedures.

## **2.4 Quality Objectives and Criteria for Measurement Data**

This section describes the required quality of the data output from the planning process used to design the investigation as well as the measurement performance criteria established to assess the field and laboratory data quality. Measurement performance criteria are established by defining acceptance criteria and quantitative or qualitative goals (e.g., control limits) for precision, accuracy, representativeness, comparability, and completeness (PARCC). The definitions of PARCC are provided below along with the acceptance criteria for data collected in support of this investigation.

### **2.4.1 Data Quality Objectives**

The data quality objectives (DQOs) for this program are presented in Section 4.0 of the Work Plan. Consistent with EPA guidelines (EPA, 2006), the DQOs describe the systematic planning of data collection activities to assure that the proper type, quality, and quantity of data are collected. The DQOs shall be fulfilled by implementation of these QA and QC activities during data collection in support of the investigation:

- Following specific sampling designs (refer to the Work Plan);
- Adherence to standardized procedures for field measurements, sampling, sample handling, and sample chain of custody (COC) procedures;
- Collection and analyses of field and laboratory QC samples, as discussed in Section 3.5.1 and in Section 3.5.2, respectively;
- Analyses of samples in accordance with standard method protocols selected to meet the project's measurement performance goals (Section 2.4.3) and detectability requirements (Section 3.4.2);
- Adherence to the laboratory analysis methods, and their associated quality control steps, specified for analyses of environmental samples (Section 3.4.2);

- Implementation of laboratory-specific preventative maintenance measures;
- Data review and reduction by the laboratories;
- Data validation; and
- Quality auditing and corrective/preventative action processes, as described in this QAPP.

#### 2.4.2 Measurement Performance Criteria - Definitions

The definitions of PARCC are provided below along with the acceptance criteria for data collected in support of the investigation. Equations for calculation of precision, accuracy, and completeness are also provided in Table 2-1.

##### Precision

Precision is the level of agreement among repeated measurements of the same characteristic. There are two general forms of uncertainty. The first is the random error component of the data collection process. The second is inherent stochastic variability, which cannot be eliminated but can be described.

Data precision is assessed by determining the agreement between replicate measurements of the same sample and/or measurements of duplicate samples. The overall random error component of precision is a function of the sampling and analytical precision and is assessed by the analysis of field duplicates. The analytical precision is determined by the analysis of field duplicates by laboratories and by replicate analyses of the same sample. An analytical duplicate is the preferred measure of analytical method precision. When analytes are present in samples at concentrations below or near the quantitation limit, precision may be evaluated using duplicate analyses of laboratory prepared samples such as duplicate laboratory control samples (LCS/LSCD) and duplicate laboratory matrix spike samples (MS/MSD).

Precision can be measured as relative percent difference (RPD) or as relative standard deviation (RSD; also known as a coefficient of variation). Formulae for both are presented in Table 2-2.

##### Accuracy

Accuracy is the degree of difference between the measured or calculated value and the true value. It is a measure of the bias or systematic error of the entire data collection process. Potential sources of systematic errors include:

- sample collection methods;
- physical or chemical instability of the samples;
- interference effects during sample analysis;

- calibration of the measurement system; and
- contamination.

Data accuracy or analytical bias may be evaluated by the analysis of laboratory control samples (LCS) and/or matrix spike (MS) samples, with results expressed as a percentage recovery measured relative to the true (known) concentration (refer to Table 2-2 for percent recovery calculations).

Field equipment and laboratory blanks may be analyzed to assess artifacts introduced during sampling, transport, and/or analysis that may affect the accuracy of the data. In addition, initial and continuing calibration verification samples (ICV and CCV) and initial and continuing calibration blanks (ICB and CCB) may be used to verify that the sample concentrations are accurately measured by the analytical instrument throughout the analytical run.

#### **Representativeness**

Data representativeness is defined as the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or environmental conditions. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program. Representativeness of samples shall be achieved through the careful selection of sampling locations and methods. The sampling program described in Section 5.0 of the Work Plan has been designed to provide samples that are representative of the medium being sampled as well as a sufficient number of samples to meet the project DQOs.

#### **Comparability**

Data comparability is defined as the measure of the confidence with which one data set can be compared to another. Comparability is a qualitative parameter but must be considered in the design of the sampling plan and selection of analytical methods, quality control protocols, and data reporting requirements.

#### **Completeness**

Completeness refers to the amount of useable data produced during a sampling and analysis program. The procedures established in this QAPP are designed to ensure, to the extent possible, that data shall be valid and usable. To achieve this objective, every effort shall be made to collect each required sample and to avoid sample loss.

#### 2.4.3 Measurement Performance Goals

This section identifies numerical goals for precision, accuracy, and completeness for the various environmental media. Failure to meet these goals shall be considered in the data validation process described in Section 4.0.

##### Precision

Precision shall be determined on field data and laboratory analysis data by the analysis of field duplicates, laboratory replicates, matrix spike and matrix spike duplicate results and evaluation of the RPD for these various paired measurements. The RPD goals for measures of precision associated with the analytical methods are presented in Tables 2-2 through 2-5.

##### Accuracy

Sampling accuracy shall be determined by the collection and analysis of equipment blanks, at the frequencies described in Section 3.4.

Laboratory accuracy is determined by the analysis of calibration and method blanks, calibration verification samples, laboratory control samples or standard reference materials, and matrix spike samples. Method blank goals shall be that blanks contain less than the reporting limit for each target parameter. Accuracy goals for the specific laboratory analysis methods that will be relied on to generate data for the investigation are summarized in Tables 2-2 through 2-5.

##### Representativeness

Representativeness is addressed by the description of the sampling techniques and the rationale used to select the sampling locations. Sampling methods are established by the SOPs provided in Appendix B of the Work Plan. Sample representativeness is also evaluated using the RPDs for field duplicate results and by a review of the results of field blanks (i.e., equipment blanks as appropriate to sampling methods).

Representativeness of individual sample analyses will be described on the basis of results obtained from associated laboratory quality control samples. The representativeness of sample analyses will be considered acceptable as long as any detectable concentrations of analytes in associated field and method blanks are less than the reporting limit.

##### Comparability

Comparability shall be ensured by analyzing samples obtained in accordance with appropriate SOPs and the referenced standard laboratory analysis methods. All data should be calculated and reported in units consistent with standard reporting procedures so that the results of the

analyses can be compared with those of other laboratories, if necessary. In general, data shall be reported in µg/L for water matrices.

### Completeness

The project's completeness goals are 95 percent for groundwater analyses.

## **2.5 Training Requirements**

Field personnel shall be trained in the requirements of the Work Plan and this QAPP at a project meeting prior to the initiation of field activity. All personnel shall read the Work Plan documents, including this QAPP, prior to the start of field work and shall acknowledge that they have read the documents at the time of the project meeting. In addition, prior to conducting sampling activities, the Field Investigations Manager, or designee, shall review field procedures and sampling requirements in order to better ensure that samples are collected and handled according to Work Plan and QAPP requirements. Field personnel will also be trained in the use of field equipment, decontamination procedures, and COC procedures in accordance with SOPs used for this project (refer to Appendix B of the Work Plan). One hard copy of the current approved version of the Work Plan shall be maintained for ready-reference purposes in the field vehicle or field office. All field team members shall have access to \*.pdf format files of the complete Work Plan through their personal laptop computers.

## **2.6 Documentation and Records**

This section describes the management of project documents and records, including this QAPP. All field documentation will be conducted in accordance with the procedures described in SOP No. 1, *Field Documentation* (Appendix B of the Work Plan).

### **2.6.1 Field Logbooks**

Documentation of observations in the field provides information on conditions at the time of sampling and a permanent record of field activities. Field observations and data collected during sampling activities will be recorded with waterproof ink in a permanently bound weatherproof field log book with consecutively numbered pages, or on field forms associated with the individual SOPs found in Appendix B of the Work Plan. Field forms for recording various types of sampling and measurement activities include sampling of surface water and surface water discharge measurements. The appropriate forms for sampling of various media are located in the applicable SOP (refer to Appendix B of the Work Plan). The SOPs also provide instructions for recording field activities at the time of field measurements or sample collection.

Field notebook and data sheet entries will, at a minimum, include the information listed below:

- Project name and number;
- Sample location;
- Data and time of sample collection;
- Sample identification numbers;
- Description of sample (sample matrix or species);
- Number of samples collected;
- Field measurements;
- Field observations and weather conditions;
- Personnel present;
- Sampler's signature; and
- Field filtration activities and equipment, if performed.

In addition, other ancillary information shall be recorded, including:

- personnel and/or other visitors to the sampling site(s);
- weather conditions;
- presence of livestock or wild game; and
- any unusual events.

Changes or deletions in the field book or on the data sheets will be recorded with a single strike mark through the changed entry, with the sampler's initials and the date recording the new entry. All entries must remain legible. Sufficient information should be recorded to allow the sampling event to be reconstructed without having to rely on the sampler's memory.

Completed field forms and logbooks will be copied to the project's quality records (refer to Section 2.6.4) in addition to copies of outgoing COCs and sample shipping documents.

## **2.6.2 Chain of Custody Records**

Documentation of sample custody must be maintained. Information on the custody, transfer, handling, and shipping of samples shall be recorded by field personnel on a COC form as specified in SOP No. 2 (Appendix B of the Work Plan), and as described in greater detail in Section 3.2.3 below.

A COC form shall be completed for each set of samples collected daily and shall contain the following information:

- sampler's signature and affiliation;
- program name and identification number;

- date and time of collection;
- sample identification number and matrix;
- analyses requested;
- number of containers;
- signature of persons relinquishing custody, dates, and times;
- signature of persons accepting custody, dates, and times;
- method of shipment; and,
- shipping papers/waybill identification number (as appropriate).

A copy of each as-transmitted COC form shall be retained in the program quality records (refer to Section 2.6.4).

### **2.6.3 Analytical Laboratory Records**

Results received from the laboratory will be documented both in report form and in electronic format. Original hard copy and/or electronic reports and data files received from laboratories will be maintained with the program quality records, as described below. Section 4.0 presents the project's laboratory reporting requirements in detail. The final deliverable ("data package" or "report") issued to Sunnyside and Formation will include data necessary to complete validation of laboratory results in accordance with specifications included in Section 4.0.

### **2.6.4 Program Quality Records**

Program quality records are defined as completed, legible documents that furnish objective evidence of the quality of items or services, activities affecting quality, or the completeness and quality of data. These records shall be organized and managed by Formation and shall include, at a minimum:

- copies of all bound field logbooks;
- copies of all field documentation forms;
- field copies and original (laboratory) copies of all COC forms;
- incoming and outgoing program correspondence (letters, telephone conversation records, and e-mail messages);
- copies of all laboratory agreements and amendments thereto;
- as-received laboratory data packages (hard copy and/or electronic);
- complete laboratory data validation packages;
- documentation of field and/or laboratory audit findings and any corrective actions;
- draft and final versions of all monthly and quarterly reports; and,

- draft and final delivered versions of the investigation report(s) and supporting procedures such as statistical analyses, numerical models, etc.

The other documentation included in the program's quality records include the approved Work Plan and QAPP, any approved revisions or addendums to the Work Plan and QAPP, and SOPs referred to for field data collection with any updates, revisions, or addendums to those SOPs approved by the Project Managers and Field Investigations Manager to address specific conditions encountered during the field investigation

## 3.0 DATA GENERATION AND ACQUISITION

The elements in this section address management of data generation and acquisition activities.

### 3.1 Surface Water Sampling Design

The Work Plan provides a detailed description of the sampling design, including the proposed sample locations, and total numbers of samples needed to complete the investigation. Below is a description of the investigation methods. The SOPs included in Appendix B of the Work Plan provide a more detailed description of those procedures, and they also provide information on field documentation and QA activities for the sampling team.

#### 3.1.1 Surface Water Sampling Locations and Frequencies

Comprehensive sampling activities, including sampling locations and frequencies, are summarized in the Work Plan. The number and types of samples that will be collected and sampling locations are detailed in Sections 5.1 and 5.2 of the Work Plan.

#### 3.1.2 Surface Water Sampling Methods

Surface water samples will be collected in accordance with methods specified in SOP No. 5, *Water Quality Sampling* (Appendix B of the Work Plan). One or more of the eight sampling methods described in the SOP will be used for the collection of the surface water samples. It is anticipated that the majority of the surface water samples will be collected using the “Dipper Method”. The Dipper Method utilizes a sample container attached to a pole that is then dipped into the water body and the sample is collected as a “grab sample” from just below the surface of the water. During sample collection, care will be taken to minimize disturbance of sediment at the bottom of the water body. Samples will be collected in sequential order from the furthest downstream location to the furthest upstream location, unless the sampler does not enter the water, in which case samples can be collected in the order selected by the sampling team(s) based on field logistics. Prior to sample collection, field parameters will be measured with a water quality instrument(s) in accordance with the procedures described in SOP No. 5, *Water Quality Sampling* (Appendix B of the Work Plan). Field parameters include: temperature, turbidity, pH, specific conductance, dissolved oxygen (DO), and oxidation reduction potential (ORP). Calibration of the instrument(s) used to measure the field parameters is described in Section 3.6.1 of this QAPP. The water quality meter(s) will be calibrated in accordance with SOP No. 31, *Water Quality Meter Calibration* (Appendix B of the Work Plan). All non-dedicated sampling equipment will be decontaminated between each sample location in accordance with the procedures described in SOP No. 7, *Equipment Decontamination* (Appendix B of the Work

Plan). Documentation for field sampling is described in Section 2.6 of this QAPP and sample, handling, preservation and custody procedures are described below.

During high-flow conditions, it may be unsafe for personnel to enter the stream at a particular sample location. The health and safety plan (HASP) for this investigation is included in Appendix C of the Work Plan and includes a job safety analysis (JSA) that describes recommended safe job procedures for stream monitoring.

### **3.2 Sample Handling, Preservation, and Custody**

This section describes sample handling requirements and COC procedures from the sample collection step through laboratory analysis and ultimate disposal. Sample custody, packaging, and shipment procedures are described in SOP No. 2, *Sample Custody, Packaging and Shipment* (Appendix B of the Work Plan).

#### **3.2.1 Sample Labeling**

Each sample that is collected in the field will be labeled for future identification. Sample labels may be filled out as completely as possible by a member of the sampling team prior to the start of the day's field sampling activities. Samples will be labeled with all necessary information on pre-printed waterproof labels using waterproof ink. At a minimum, each sample label shall contain the following information:

- location identification;
- sample identification number (including codes for site location, sample matrix, and sample type, described in further detail below);
- date and time of sample collection;
- analyses required;
- method of preservation, if used;
- sample matrix;
- sample depth, if applicable, and
- sample type (e.g., right bank inflow [RBI], left bank inflow [LBI], and in stream [S])

Each sample shall be assigned a unique sample identification number. These numbers are required for tracking the handling, analysis, and verification or validation status of all samples collected during monitoring. Each sample identification number will identify the sampling location and type of sample. Samples to be collected will include planned surface water samples, opportunistic surface water samples, and QC samples.

For planned surface water samples sample identification numbers will be assigned using several codes as follows:

Sampling Event - Location - Media -Type

SS0515-4023-SW

The first field in the identification number identifies the project location and event month and year. This example includes the project location, "SS" (Sunnyside) and an event month and year of "0515" (May 2015).

The second field in the identification number identifies the location of the sample. In this example, "4023" indicates surface water sample location as the sampling location. Location identifiers have already been established and are included on Table 5-3 of the Work Plan.

The third field identifies the sample matrix type. The matrix type is defined as "SW" to designate the matrix is surface water.

Note that additional codes may be added as the project proceeds. The additions will be communicated immediately to the field staff and data management team.

For opportunistic surface water samples, sample identification numbers will be assigned using the following codes:

Sampling Event - OP - Number

SS0515-OP-01

For opportunistic surface water samples, the first field in the identification number identifies the project location and event month and year. This example includes the project location, "SS" (Sunnyside) and an event month and year of "0515" (May 2015).

The second field in the identification number identifies the sample as an opportunistic sample and the third field identifies the opportunistic sample. Opportunistic samples will be numbered consecutively starting with 1. Up to 15 opportunistic samples may be collected. Field personnel will record the actual sample location and time in field log books.

For QC samples sample identification numbers will be assigned using the following codes:

Sampling Event - OP - Number

SS0515-OP-16

For QC samples, the first field in the identification number identifies the project location and. This example includes the project location, "SS" (Sunnyside) and an event month and year of "0515" (May 2015).

The second field in the identification number identifies the sample as a QC sample and the third field identifies the QC sample. QC samples will be numbered consecutively starting with 16. Field personnel will record the type of QC sample (e.g., rinsate blank, filter blank, or field duplicate) and the time of sample collection in field log books.

Samples will be immediately labeled in the field and sample numbers shall be recorded at the time of sampling in field notes and on field data collection forms.

### **3.2.2 Sample Containers, Preservation, and Holding Times**

#### Sample Containers

The laboratory will provide new, certified pre-cleaned, prepared sample containers for aqueous sample matrices (i.e., surface water, rinsates, etc.), appropriate to the list of analyses to be requested and as specified on Table 3-1.

#### Sample Preservation and Storage

Samples are preserved in order to prevent or minimize chemical changes that could occur during transit and storage. Sample containers containing appropriate preservative are used to ensure preservation immediately upon sample collection. The contracted laboratories will provide containers and appropriate preservatives (i.e., "pre-preserved" containers), as needed for the analyses to be requested.

Aqueous samples (surface water, equipment rinsates) submitted for metals/metalloids analyses require preservation upon collection, as specified in Table 3-1. Preservation requirements are associated with the individual analyses to be performed and the referenced analytical methods.

#### Sample Holding Times and Analyses

Sample holding times are established to minimize chemical changes in a sample prior to analysis and/or extraction. A holding time is defined as the allowable time between sample collection and analysis recommended to ensure accuracy and representativeness of analysis results, based on the nature of the analyte of interest and chemical stability factors.

Immediately after collection, samples shall be placed in field coolers with wet ice and/or blue ice. If there is no likelihood that a holding time will be violated, samples may be transferred to a locked refrigerator for one or more days of storage prior to shipping to a laboratory. Transfer to

the laboratory for analysis should be prompt to minimize the possibility of exceeding holding times.

Holding times for the chemical constituents for which samples will be analyzed are summarized in Table 3-1. Failure to conduct analyses within the required holding times may potentially require the qualification of associated analytical results and shall prompt appropriate corrective and preventive action measures as outlined in Section 4.4.

### **3.2.3 Sample Handling and Chain of Custody**

#### Sample Handling and Shipping

After collection, sample labels will be completed (refer to Section 3.2.1 above), and the samples will be placed on ice in an insulated cooler. The sample bags or jars will be placed in re-closeable freezer-type plastic storage bags. Each sample container will be carefully packaged in a shipping container, typically an ice chest, with Styrofoam® peanuts, vermiculite or other packing material to prevent breakage during shipment. Ice placed in the cooler will be double-bagged to prevent leakage of water. The coolers will be taped shut and the tape will be placed over the custody seal.

#### Chain of Custody

After samples have been collected, they will be maintained under strict COC protocols. The field sampling personnel will complete a COC form (refer to SOP No. 2, Appendix B of the Work Plan) for each shipping container (i.e., cooler, ice chest or other container) of samples to be delivered to the laboratory for analysis. The sampler is responsible for initiating and filling out the COC form. The COC for a shipping container will list only those samples in that shipping container. Information contained on the triplicate, carbonless COC form will include the following:

- Project number;
- Date and time of collection;
- Sample identification number;
- Sample matrix;
- Analyses requested;
- Number of containers/bags for each sample;
- Sample preservation;
- Field filtration, if applicable;
- Sampler's signature and affiliation;
- Signature of persons relinquishing custody, dates, and times;

- Signature of persons accepting custody, dates, and times;
- Method of shipment;
- Shipping air bill number (if the samples are shipped);
- Condition of samples and cooler temperature upon receipt by laboratory; and
- Any additional instructions to the laboratory.

Any documentation, including COCs, placed inside the cooler during sample shipment, should be placed inside a re-closeable plastic bag.

The sampling personnel whose signature appears on the COC is responsible for the custody of the samples from the time of sample collection until custody of the samples is transferred to a designated laboratory, a courier, or to another project employee for the purpose of transporting the sample to the designated laboratory. The sample is considered to be in custody when the sample is: (1) in the direct possession of the sample custodian; (2) in plain view of the sample custodian or (3) is securely locked in a restricted-access area by the sample custodian. Custody is transferred when both parties to the transfer complete the portion of the COC under "Relinquished by" and "Received by." Signatures, printed names, company names, dates and times are required. Upon transfer of custody, the sampling personnel who relinquished the samples will retain the third sheet (pink copy) of the COC. When the samples are shipped by a common carrier, a Bill of Lading supplied by the carrier will be used to document the sample custody, and its identification number will be entered on the COC. Copies, receipts and carbons of Bills of Lading will be retained as part of the permanent documentation in the project file. It is not necessary for courier personnel to sign the COC.

When the analytical laboratory receives the samples, the COC will be immediately signed along with the date and time of receipt. The top sheet (white copy) or a copy of the COC may be returned with the final analytical report. The laboratory will follow appropriate chain-of-custody procedures when shipping any samples to a subcontracted laboratory for analysis. A copy of all inter-lab COCs will be included with the final analytical report.

#### Laboratory Sample Handling and Storage

Upon receipt by the laboratory, the samples will be inspected for sample integrity and proper preservation, including temperature. The COC will be reviewed to verify completeness. Any discrepancies between the COC and sample labels and any problems or questions noted upon sample receipt will be communicated immediately to the Formation QA Manager. The laboratory shall provide the Formation QA Manager with a copy of the COC, and associated sample-receipt information, within 2 working days of receipt of samples. The sample-receipt information routinely provided will include: sample receipt date, sample ids transcribed from the COCs, sample matrix type, list of analyses to be performed for each sample, and verification of sample temperatures and preservation requirements. Broken custody seals, damaged sample

containers, sample labeling discrepancies between container labels and the COC form, and analytical request discrepancies shall be noted on the COC form. The Formation QA Manager shall be notified of any such problems; discrepancies or non-conformances shall be resolved and addressed prior to the samples being released to the laboratory for analysis.

The laboratory will store the samples in a specially designated area, which is clean and maintained at the appropriate preservation temperature, if necessary. The laboratory will be responsible for following their internal custody procedures from the time of sample receipt until sample disposal. At a minimum, the following procedures shall also be in place for laboratory storage of samples:

- samples and extracts shall be stored in a secure area controlled by the laboratory's designated sample custodian;
- samples shall be removed from the shipping container and stored in their original containers unless damaged; damaged samples shall be disposed in an appropriate manner after notifying the Formation QA Manager, and authorization to dispose is received and documented;
- whenever samples are removed from storage, removal shall be documented;
- sample transfers shall be documented on internal COC records;
- samples and extracts shall be stored after completion of analyses in accordance with contractual requirements; and
- samples shall not be stored with standards or sample extracts.

### 3.3 Stream Discharge Measurements

Manual stream discharge measurements will be conducted, where feasible, in accordance with the methods described in SOP No. 6, *Surface Water Discharge Measurement* (Appendix B in the Work Plan). The selection of a discharge measurement method depends on stream flow rate and/or specific channel characteristics. It is anticipated that the "Velocity-Area Method" will be used for measurement of stream discharge. This method utilizes a velocity meter, which requires field personnel to enter the stream and take measurements across the cross-section of the stream. For areas where flows are too small or stream gradients are too high, the "Volumetric Method" may be appropriate.

During high-flow conditions, it may be unsafe for personnel to enter the stream at a particular sample location. The health and safety plan (HASP) for this investigation is included in Appendix C of the Work Plan and there is a job safety analysis (JSA) that describes recommended safe job procedures for stream monitoring. If it is determined, based on the JSA, that conditions are unsafe then a measurement will not be taken.

### 3.4 Analytical Methods

Samples will be prepared and analyzed using standard laboratory procedures and methods according to performance criteria identified in the following sections.

#### 3.4.1 Sample Preparation

The laboratory analytical parameters and targeted method detection limits and/or quantitation limits and analytical methods for the laboratory analyses are specified in Table 3-2. A copy of the appropriate sample-analysis and method table, by sample type and sampling task, will be included in each batch of samples submitted to the laboratory for analyses to accurately document the analyses being requested.

Sample preparations shall be in accordance with the method specifications included in Table 3-2, or method 200.2 for total recoverable metals, as well as standard laboratory practices.

#### 3.4.2 Target Analyses and Methods

The target analytes (TAs) for the project include both laboratory and field parameters and are described in detail in Section 5.1 of the Work Plan. Laboratory parameters are listed in Table 3-2 of this QAPP. As summarized in Table 5-1 in the Work Plan, the results of the laboratory analyses for all metal TAs will be presented as dissolved (samples field filtered with a 0.45 micron filter) and total recoverable.

### 3.5 Quality Control

There is potential variability in any sample collection, analysis, or measurement activity. This section describes checks that will be performed to evaluate that variability.

#### 3.5.1 Field Quality Control Samples

Field quality control samples are introduced into the measurement process to provide information on transport, storage and field handling biases and on field sampling precision. Field blank samples and field duplicate samples will be collected. Field blank samples may be identified to the laboratory so that they are not used for preparation of an analytical duplicate or matrix spike sample. Descriptions and frequencies of these QC samples are provided below. Table 3-3 summarizes the minimum required frequencies for the field QC samples.

##### Field Blank Samples

Two types of field blanks will be collected: filter and equipment rinsate.

A filter blank quantifies artifacts that could be introduced into the sample during filtration. One filter blank will be collected for the batch of filters used during sample collection. The sample will consist of one total and one dissolved sample bottle whose analytical results can be compared. Analyte-free reagent-grade water (e.g., ASTM Type II) will be poured directly into a clean sampling bottle for total metals analysis and preserved as needed. In addition, analyte-free reagent-grade water will also be poured through a filter into a separate clean sampling bottle for dissolved metal analysis, and preserved as needed. The total metals analysis bottle will be analyzed for all metals in Table 3-2. The dissolved bottle will be analyzed for all metals in Table 3-2.

Analyses of equipment rinsate blanks quantify artifacts introduced into the sample during collection. Potential sources of bias or cross-contamination include sampling gloves and sampling equipment that may incidentally come into contact with the sample. An equipment rinsate blank consists of analyte-free reagent-grade water (e.g., ASTM Type II) poured through the sampling equipment, collected in a clean suite of sample bottles, and preserved as needed. The equipment rinsate blanks will be analyzed for total metals analyses for all metals in Table 3-2 as well as hardness, fluoride, chloride, sulfate, and bromide. Equipment rinsate samples will be collected at rate of 1 per every 20 field samples (see Table 3-3).

#### Field Duplicates

Field duplicates are collected to measure the sampling and analytical variability associated with the sample results. Duplicate samples are usually collected simultaneously with or immediately after the corresponding original samples have been collected, depending on the sample type and medium and consistent with detailed instructions in the relevant SOPs for sample collection. In all cases, the same sampling protocol is used to collect the original sample and the field duplicate sample. The field duplicate is analyzed for the same suite of analytical parameters as the original sample. There are no EPA criteria for evaluation of field duplicate sample comparability; however, the RPD between the original sample and field duplicate can be calculated for each parameter and compared to the project's precision goal. Analytical data for the field duplicate pairs will be qualified based on the field duplicate RPD results. For surface water field duplicate pairs with RPDs greater than 30% (if sample and duplicate concentrations are  $\geq 5X$  Reporting Limit) field duplicate pair results will be qualified as estimated ("J" detects and "UJ" for nondetects) and professional judgment will be used regarding flagging other samples in the data set. Possible causes for the observed variability in duplicate samples should be evaluated and explained in the investigation report.

For surface water, field duplicates will be collected at a rate of 1 per 20 samples.

### 3.5.2 Laboratory Quality Control Samples

Laboratory quality control samples are introduced into the measurement process to evaluate laboratory performance and sample measurement bias. Control samples may be prepared from environmental samples or be generated from standard materials in the laboratory. The appropriate type and frequency of laboratory QC samples will be dependent on the sample matrix, analytical method, and the laboratory's SOP. Laboratory QC samples will be analyzed in addition to the calibration samples with each QC batch.

Table 3-3 summarizes the minimum required frequencies for the laboratory QC samples. A laboratory method blank, laboratory control sample, analytical duplicate, and a pair of matrix spike samples should be run in each laboratory QC batch at a frequency of one each per 20 field samples shown in Table 3-3. Field staff responsible for collection and shipping of samples to the laboratory shall designate the samples to be used for laboratory QC analyses on the COC forms. In the event that such instructions are not included, the laboratory shall always utilize samples submitted from the investigation for preparation of laboratory duplicates and matrix spike samples used for batch QC analyses.

#### Method Blanks

Method blanks shall be used for the laboratory processes. A method blank is a volume of deionized water that is carried through the entire sample preparation and analysis procedure. The method blank volume or weight shall be approximately equal to the sample volumes or sample weights being processed. Method blanks are used to monitor interference caused by constituents in solvents and reagents and on glassware and other sampling equipment.

Project target analytes must not be detected in laboratory method blanks at concentrations greater than the Reporting Limit (RL). Method blank contamination, if found, will be addressed in accordance with the response actions given in Tables 2-2 through 2-5, as appropriate to the analytical methods. Method blanks will be evaluated during the data validation process, and associated sample results may be qualified on the basis of blank contamination.

#### Laboratory Control Samples and Standard Reference Materials

A laboratory control sample (LCS)/laboratory fortified blank (LFB), or a blank spike, is an aqueous or solid control sample of known composition that is analyzed using the same sample preparation, reagents, and analytical methods employed for the program samples. An LCS/LFB is obtained from an outside source or is prepared in the laboratory by spiking reagent water or a clean solid matrix for a stock solution that is different than that used for the calibration standards. The LCS/LFB is the primary indicator of process control used to demonstrate whether the sample preparation and analytical steps are in control, apart from sample matrix effects. LCS/LFB samples will be run with all samples at the frequencies specified herein.

### Analytical Duplicates

Analytical duplicates are samples that are split at some step in the measurement process and then carried through the remaining steps of the process. Duplicate analyses provide information on the precision of the operations involved.

- Analytical duplicates are a pair of subsamples from a field sample that are taken through the entire preparation and analysis procedure; any difference between the results indicates the precision of the entire method in the given matrix.
- Under certain method protocols (refer to Tables 2-2 through 2-5), the matrix spike is duplicated, to provide a matrix spike duplicate, and serves as the analytical duplicate sample.

Analyses of analytical duplicates and/or matrix spike duplicates monitor the precision of the analytical process.

### Matrix Spikes

A matrix spike is prepared by adding an analyte to a subsample of a field sample before sample preparation and analysis. For multi-analyte methods, a representative suite of the analytes is used in the matrix spike. From the concentrations of the analyte in the spiked and unspiked samples, a percent recovery is calculated. Many samples show matrix effects in which other sample components interfere with the determination of the analyte. The value of the percent recovery indicates the extent of the interference.

Laboratory matrix spike samples are used to evaluate potential sample matrix effects on the accurate quantitation of an analyte using the prescribed analytical method. Percent recoveries of target analytes from matrix spike samples should fall within the prescribed control limits. Matrix interference and other effects may cause low or high percent recoveries in investigative samples; matrix effects may be noted at the same time that recoveries from laboratory control samples indicate acceptable method performance.

Site-specific samples need to be used for MS/MSDs. Field sampling personnel will collect extra volume and designate on the COC forms the samples that are to be used for the MS/MSD. Every effort will be made to ensure that these samples are representative of the general sample matrix of samples collected on that sampling data. Equipment rinsate samples are not designated for MS/MSD.

The laboratories will be instructed to use spike concentrations that are consistent with criteria provided in the National Functional Guidelines for Inorganic Data Validation (EPA, 2004) and any specific instructions provided in the referenced analytical methods.

### Performance Evaluation Samples

Program-specific laboratory performance evaluations via performance evaluation samples are not anticipated as part of this investigation, but may be performed if analytical or validation exercises indicate the presence of potential laboratory QA issues.

## **3.6 Instrument/Equipment Calibration and Maintenance**

In order to ensure continual quality performance of any instruments or equipment, calibration and maintenance shall be performed and recorded as described in this section.

### **3.6.1 Field Equipment**

Preventative maintenance of field equipment will include routine inspection and either calibration or testing as specified in the relevant SOP or manufacturer's instructions.

All field equipment will be cleaned and safely stored between each use, and any routine maintenance recommended by the equipment manufacturer will also be performed. Equipment will be inspected and the calibration checked (if applicable) before it is transported to a field setting for use. Equipment will be inspected before use and field instruments that fail calibration requirements will be tagged as "nonfunctional" or "defective" and returned to the manufacturer or other supplier for repair or replacement.

Water quality parameters to be measured during groundwater sampling include pH (standard units), temperature (°C), oxidation-reduction potential (redox potential or ORP, mV), conductivity or specific-conductance ( $\mu\text{S}/\text{cm}$ ), turbidity (NTU), and dissolved oxygen (DO, mg/L). All field equipment designed to provide these measurements require daily calibration prior to use to ensure that the accuracy and reproducibility of the results are consistent with the manufacturer's specifications and the project's data needs.

Field equipment shall be calibrated using the standards specified or provided by the equipment manufacturer. Atmospheric oxygen shall be used to calibrate the dissolved oxygen element. Calibration standard usage prior to and after field activities shall be according to the manufacturer instructions. Calibration for such field equipment will be implemented in accordance with the manufacturer's guidelines.

### **3.6.2 Laboratory Equipment**

Instruments used by the laboratory will be maintained in accordance with the laboratory's Quality Assurance Plan and method requirements. All analytical measurement instruments and equipment used by the laboratories shall be controlled by a formal calibration and preventive

maintenance program. In addition, each laboratory's preventive maintenance program shall include the following, as a minimum:

- a listing of the instruments and equipment;
- the frequency of maintenance considering manufacturer's recommendations and previous experience with the equipment; and
- a file for each instrument containing a list of spare parts maintained, external contracts, and a listing of the items to be checked or serviced during maintenance.

The laboratory will keep maintenance records and make them available for review, if requested, during laboratory audits. Laboratory preventative maintenance will include routine equipment inspection and calibration at the beginning of each day or each analytical batch, per the laboratory's internal SOPs and method requirements.

### **Calibration Methods**

Physical and chemical calibrations shall be performed within each laboratory as specified by the EPA Methods, instrument manufacturer's guidelines, and this project's calibration requirements for the requested EPA methods, which are summarized in Tables 2-3 through 2-5. When laboratory measurement instruments do not meet the calibration criteria of the laboratory's Quality Assurance Plan and/or EPA method, then the calibration data will be reviewed using the NFGs (EPA, 2004) and will be qualified accordingly. Calibration records and demonstration of acceptable calibration results will be required elements of the laboratory's data reporting. Records of calibration, repairs, or replacement will be filed and maintained by the designated laboratory personnel performing QC activities. These records will be filed at the location where the work is performed and will be subject to QA audit.

Calibration procedures for a specific laboratory instrument will consist of initial calibration (blank and standards), initial calibration verification (ICV) and continuing calibration verification (CCV). All analyses will be governed by the appropriate laboratory SOPs, and appropriate calibration procedures and frequencies can be found in each SOP.

For a summary of the calibration procedures for individual methods, refer to Tables 2-2 through 2-5. Calibration and quality control sample procedures for trace metals analysis by EPA Method 200.8 (inductively coupled plasma-mass spectrometer [ICPMS]) are provided in Table 2-2. Calibration and quality control sample procedures for trace metals analysis by EPA Method 200.7 (inductively coupled plasma [ICP]) are provided in Table 2-3. Calibration and quality control sample procedures for alkalinity by Method SM2320B are provided in Table 2-4. Calibration and quality control sample procedures for bromide and sulfate by EPA Method 300.0 are provided in Table 2-5.

### **3.7 Acceptance Requirements for Supplies and Consumables**

All supplies and consumables received for a project (e.g., sample bottles, calibration standards) will be checked for damage and other deficiencies that would affect their performance. All inspections should be documented and a copy of the inspection should be kept in the project's file.

### **3.8 Criteria for Use of Existing, Non-Direct Measurement Data**

Previous investigations may provide environmental data that are relevant to this investigation. These data are summarized in Section 3.1.7 of the Work Plan and will be used to the fullest extent practicable in the on-going investigation and considering the data quality.

### **3.9 Data Management**

The program quality records will be maintained by Sunnyside's contractor, Formation, in their Boulder, CO office. These records, either electronic or hard copy in form, shall include:

- Project work plans, including this QAPP, with any approved modifications, updates, and addendums;
- Field documentation (including well logs, GPS data on monitoring locations including surveyed elevations of monitoring wells);
- COC records;
- Laboratory documentation (results received from the laboratory will be documented both in report form and in an electronic format);
- Data validation reports;
- Data Summary Reports; and
- Final project reports/deliverables.

Hard-copy field and laboratory records shall be maintained in the project's central data file, where original field and laboratory documents are filed chronologically for future reference. These records are also scanned to produce electronic copies in \*.pdf format. The electronic versions of these records are maintained on Formation's central server system with backup scheduled on a daily basis.

A key element of the project's data management process is maintenance of an electronic database that is used to store relevant environmental sampling data, including existing data considered usable to support the investigation (i.e., non-direct measurement data), in a consistent, readily retrievable format. Microsoft® Access will be used for the data structure and query support, and a designated Database Manager will ensure the security and integrity of

electronically stored data. The project's electronic database will be maintained on a central server system with data backup scheduled on a daily basis.

The project database will serve as a source of data for the data presentation and analysis tasks performed to support the hydrogeologic investigation. The database will incorporate, at a minimum, sample collection information (e.g., sample identification, location, date and time of sample collected, matrix) and laboratory analytical fields specified in the project EDD requirements (Table 3-5).

Prior to incorporation of field and laboratory data into the project database, the data and supporting documentation shall be subject to appropriate review, as described below in Section 4.0, to ensure the accuracy and completeness of original data records. Field data that has been reviewed in a hard-copy format will be entered into electronic data files for upload to the project database. All manual data entry into an electronic format will be reviewed by a separate party before such data are incorporated into the project's database (see Section 4.1). Laboratory EDDs and related data packages will be reviewed as part of the data validation process, as described in Sections 4.2 and 4.4.

Following these review steps, field and laboratory electronic data files will be imported to the project database. The data validators (refer to Section 4.4) will add qualifiers and related information to the database, for reference by all data users. The EPA flags, Reason Codes, and final, qualified data will be uploaded from electronic files that the data validators populate and return to Sunnyside/Formaation, as discussed in Section 4.0. Standardized data import formats and procedures will be used to upload both field and laboratory data into the electronic database. At this time, standardized station identifiers, parameter names, numerical formats, and units of measure are applied to the original information to facilitate comparability across all datasets and within the database.

## **4.0 DATA REVIEW, VALIDATION AND USABILITY**

The following sections address the final project checks conducted to confirm that the data obtained meet the project objectives and to estimate the effect of any deviations on data usability.

### **4.1 Field Data Review**

Raw field data shall be entered in field notebooks; and/or sample collection record forms, which shall be reviewed for completeness by the Field Investigations Manager, or his/her designated Field Supervisor, at the end of each day. The overall quality of the field data from any given sampling round shall be further evaluated during the process of data reduction and reporting.

Field data reduction procedures will be minimal in scope compared to those implemented in the laboratory setting. Field data review will include verification that QC checks and calibrations are recorded properly in the field logbooks and/or data sheets and that any necessary and appropriate corrective actions were implemented and recorded. Such data will be written into field logbook and/or data sheets immediately after measurements are taken. If errors are made, results will be legibly crossed out, initialed and dated by the field member, and corrected in a space adjacent to the original (erroneous) entry. Later, the appropriate Field Supervisor will proof the field logbooks and/or data sheets to determine whether any transcription errors have been made by the field crew. If transcription errors have been made, the appropriate Field Supervisor and field crew will address the errors to provide resolution.

Field measurement data will be entered into electronic files for import to the project's database. Data entries will be made from the reviewed field data sheets or logbooks, and all data entries will be reviewed by a separate party before the electronic file is provided to the database manager. Electronic files of field measurement data will be maintained as part of the project's quality records.

### **4.2 Laboratory Data Review**

Internal laboratory data reduction procedures will be according to the laboratory's Quality Management Plan. At a minimum, paper records shall be maintained by the analysts to document sample identification number and the sample tag number with sample results and other details, such as the analytical method used (SOP #), name of analyst, the date of analysis, matrix sampled, reagent concentrations, instrument settings, and the raw data. These records shall be signed and dated by the analyst. Copies of any strip chart printouts (such as gas chromatograms) will be maintained on file. Periodic review of these records by the laboratory QA Manager takes place prior to final data reporting to Sunnyside.

QC data (e.g., laboratory duplicates, LCS/LFB, SRMs [standard reference material], MSs, and MSDs) will be compared to the method acceptance criteria. Data considered to be acceptable will be entered into the laboratory computer system. Data summaries will be sent to the laboratory QA Manager for review. If approved, data are logged into the project database format. The laboratory shall appropriately flag unacceptable data in the data package.

#### 4.2.1 Laboratory Data Reporting Requirements

The laboratories shall prepare complete data packages for transmittal of results and associated quality control information to Sunnyside and Formation in general accordance with the following instructions, which are based on the EPA's contract laboratory program (CLP) Statement of Work. Deviations from these specifications may be acceptable provided the hard-copy report presents all of the requested types of information in an organized, consistent, and readily reviewable format. Laboratories providing data packages for this project shall be responsible for reviewing the following requirements, notifying Formation of any differences between their reports and these requirements, and confirming the acceptability of their intended report content and format with Formation before any laboratory data reports are generated for this project.

Each hard-copy report will be paginated and organized with a table of contents. A cross reference that correlates the client or field identification as provided on the chain-of-custody document with the laboratory's sample identification will be included.

For each batch of sample results consisting of 20 or fewer samples analyzed together and sharing common QC data, the laboratory data will be presented on a form equivalent to the EPA CLP "Form 1" (see below). Case narratives will be prepared which will include information concerning data that fell outside laboratory acceptance limits, and any other anomalous conditions encountered during sample analysis.

CLP Form 1 contains all required data for field samples. The Form 1 (or equivalent reporting mechanism) will provide the following information:

- Field sample identification;
- Laboratory sample identification;
- Sample result, with appropriate units, method detection limit, and reporting limit. [analyte concentrations equal to or greater than the method detection limit (MDL) will be reported. Concentrations between the MDL and reporting limit will be flagged as an estimated value ("J") by the laboratory. Parameters that are not detected or not present at concentrations equal to or greater than the MDL are flagged by the laboratory as "U" and interpreted to be not detected at a value equal to or greater than the MDL. Any non-detected value ("U" flagged) will be reported with its reporting limit and MDL.];
- Sample collection and receipt dates;
- Sample preparation date/time;

- Analysis date/time;
- Dilution factor;
- Preparation batch number or identification;
- Analysis batch number or identification;
- Sample matrix and instrument;
- Percent moisture determination; and
- For solid-matrix samples, identify basis of reporting (i.e., wet-weight or dry-weight basis).

The following additional information will be provided with the Form 1s, as applicable for the reported analytical methods. QC batch will be clearly associated with each sample (on the CLP Form specified, or an equivalent reporting mechanism):

- Case narrative;
- Chain-of-custody;
- Summary of all field sample results (Form 1s, or equivalent, as described above);
- Sample results and preparation blank;
- Initial calibration verification (ICV), and continuing calibration verification (CCV);
- Initial calibration blanks (ICB), continuing calibration blank (CCB), and preparation blanks;
- Low-Level Calibration Check Sample Summary, if necessary
- Inductively coupled plasma (ICP) interference check sample or spectral interference check sample (CLP Form IVA-IN);
- Matrix spike (MS) or analytical spike, and when applicable matrix spike duplicate (MSD) or analytical spike duplicate, sample recovery and, when applicable, MS/MSD relative percent difference (RPD);
- Laboratory duplicate precision, where applicable;
- Laboratory control sample (LCS)/laboratory fortified blank (LFB) recovery;
- MDLs;
- ICP interelement correction factors;
- ICP and ICPMS linear ranges;
- Preparation log;
- Analysis run Log;
- ICPMS tunes;
- ICPMS internal standards relative intensity summary;
- Sample log-in sheet; and
- Deliverables inventory sheet.

In addition to this standard data package, the laboratory shall deliver a “Level 4” data package, as detailed below, when requested. The Level 4 Data Package includes all items specified above plus instrument raw data and/or documentation of the following:

- Calibration standards (including source, preparation date).
- Blanks (ICB, CCB, and preparation).
- ICV, CCV standards.
- Low-Level Calibration Check Sample or Practical Quantitation Verification Standards.
- Interference check samples.
- LCS/LFB.
- Diluted and undiluted samples.
- Dilution factors.
- Sample volumes.
- Laboratory duplicates.
- Matrix spikes (source, concentration, volume).
- Method of standard addition results.
- Instrument identification.
- Analysis date and time.
- All inorganic methods: full raw data printouts from instruments.
- Full run log for each analysis. and
- ICPMS to include: internal standard recoveries, tune data (atomic mass unit [amu] and peak width), and molecular interference check data.

#### **4.2.2 Laboratory Electronic Data Deliverable**

Each data package, as described above, shall be accompanied by an electronic data deliverable (EDD) prepared by the laboratory. The content and format of laboratory EDDs are specified in Table 3-5. Additional laboratory QC data can be included in the EDD as long as the data fields specified in Table 3-5 are also maintained. The last 6 fields in the table will be populated during data validation.

EDDs will be cross checked against corresponding hard-copy data reports to confirm consistency in results reported in these two separate formats. This cross check will take place as part of the data validation process described in Section 4.4.

#### **4.3 Specific Quality Control Assessment Procedures**

The accuracy, precision, completeness, and representativeness of analytical data will be described relative to the project's control limits through a process of field and laboratory data quality review and data validation. Results from these reviews will be documented in routine Data Summary Reports prepared for all data users, including the EPA and supporting agencies, and any qualification of the data resulting from that review will also be incorporated into the project's electronic database so that all data users are aware of any uncertainties associated with individual results.

#### **4.4 Data Validation**

Data validation is the process of verifying that qualitative and quantitative information generated relative to a given sample is complete and accurate. Data validation procedures shall be performed for both field and laboratory operations as described below and in SOP No. 20, *Data Review and Validation* (Appendix B of the Work Plan).

##### **4.4.1 Evaluating Field Data**

The results of field quality control sample analyses associated with each laboratory data package will be reviewed to allow for evaluation of equipment blanks and other field QC samples and further indications of the data quality. If a problem is identified through the review of field QC data, all related field samples will be identified, and if possible, corrective actions can be instituted and documented. If data are compromised due to a problem identified via field QC sample review, appropriate data qualifications will be used to identify the data for future data users.

The handling, preservation, and storage of samples collected during the sampling program will be monitored on an on-going basis. The project laboratories will document sample receipt including proper containers and preservation at the time samples are logged into their individual laboratory. The sample receipt records (a required data package deliverable) as well as the COC documentation will also be assessed during data validation. Sample handling, storage or preservation problems identified during data validation will result in appropriate qualification of data.

##### **4.4.2 Evaluating Laboratory Chemistry Data**

The purpose of chemistry data validation is to verify that the data are of known quality, technically valid, defensible, and usable for their intended purpose. The objectives of the data validation process will be to:

- Verify completeness of data packages and corresponding EDDs;

- Assess compliance to project specific procedures and programs;
- Evaluate system process control through review of control charts (if applicable);
- Verify that no systematic errors exist within the data sets;
- Assess field QC samples to determine if sampling has adversely impacted the reported results and, therefore, usability;
- Assess both method and laboratory performance through tabulation of QC outliers; and
- Provide measures of data quality in terms of precision, accuracy, and completeness so that overall usability can be determined.

Data validation will be performed using the general protocols and processes described in the following documents and in SOP No. 20, *Data Review and Validation* (Appendix B of the Work Plan), as applicable to the method calibration and QC limits specified on Tables 2-3 through 2-5 and to the extent possible when non-CLP methods are used:

- Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (NFG; EPA, 2004); and
- Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (USPEA, 2009).

The data packages will be evaluated and qualified for quantitative QC elements (e.g., spike recoveries, method and field blank contamination, initial and continuing calibration blanks, instrument tunes, interference check samples, duplicate sample %RSD, and instrument stability and performance [e.g., initial and continuing calibration results, instrument tuning and internal standard areas]) using summary forms (described above). This validation procedure is equivalent to a “Stage 2B Validation,” as defined in the EPA guidance for labeling externally validated data (EPA, 2009).<sup>1</sup> Specific QC elements that will be reviewed include:

- Presence and completeness of COC and sample receipt documentation;
- Sample Index (correlation of field sample ID to laboratory sample ID);
- Laboratory Case Narrative (method deviations and QC anomalies);
- Analytical holding times;
- Method blank;
- Matrix spike recoveries;
- Matrix spike/matrix spike duplicate RPD values;
- Field duplicate RPD values;
- Laboratory duplicate RPD values;

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<sup>1</sup> EPA, 2009. Page 6: “A verification and validation based on completeness and compliance checks of sample receipt conditions and BOTH sample-related and instrument-related QC results...”

- Summaries of initial and continuing calibration;
- Summaries of instrument blanks (e.g., initial calibration blank, CCB, if specified in method);
- Review of reagent/preparation blanks (inorganics);
- Review of Laboratory Control Standards (LCS);
- Instrument stability and performance (e.g., serial dilution);
- Summaries of internal standards;
- Completeness of laboratory documentation for sample receipt, sample analysis, and sample result reporting;
- Interference check samples (ICP analysis); and
- Serial dilutions (ICP analysis), if any.

Formation will indicate data qualifiers applied to individual results and reasons for application of those qualifiers. Definitions of the data qualifiers that may be applied to individual results as a result of data validation are as follows:

- U      The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
- J      The result is an estimated quantity. The associated numerical value is the approximated concentration of the analyte in the sample.
- J+     The result is an estimated quantity, but the result may be biased high.
- J-     The result is an estimated quantity, but the result may be biased low.
- R      The result is unuseable. The sample result is rejected due to serious deficiencies in meeting quality control criteria. The analyte may or may not be present in the sample.
- UJ     The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

Formation will add the following data to that EDD upon completion of validation:

Field Header “Validation Qualifier”: Populate with validation qualifiers specified above and in template reports.

Field Header “Validation Qual Reason”: Populate with a specific reason for qualification if EPA codes are not used.

Field Header “Val Status”: Populate with a code to indicate if the data has been validated or not.

Field Header “Val Person”: Populate with a code to specify the validation contractor and validator.

Field Header “Val Protocol”: Populate with a code to refer to validation procedures (QAPP or NFG, etc.) used.

Field Header “Val Notes”: Populate with additional information that is specific to a sample.

Formation will perform a Manual Validation, as defined in the EPA guidance for labeling externally validated data (EPA, 2009), on the data packages generated by the laboratories.

#### **4.5 Data Usability**

Laboratory packages summarizing the data generated for this investigation will be validated as described above. Once validated, the data will be loaded into a project database managed by Formation. Data usability will be determined by Formation based on the results of data validation and overall comparison to DQOs.

#### **4.6 Measurement Data Analysis and Reporting**

Measurement data will be reported in consistent units for each sample matrix to maintain comparability and facilitate data analyses. Concentrations in liquid samples shall be expressed in terms of weight per unit volume such as milligram per liter (mg/L). The number of significant figures in the field and laboratory data presented in the final report shall be consistent with the limits of uncertainty inherent in the measurement or analytical method.

Statistical analyses and other evaluations may be performed that consider the validated data set. The original detected values for parameters with results below the minimum reporting limit may be used as appropriate to the selected statistical methods. Statistical methods may include published methods found in statistical handbooks, textbooks, and EPA or other agency statistical guidance documents.

## 5.0 ASSESSMENT AND OVERSIGHT

Assessments of data collection and reporting activities are designed to verify that sampling and analyses are performed in accordance with the procedures established in the Work Plan and QAPP. The audits of field and laboratory activities include two independent parts: internal and external audits. Internal audits will be performed by Sunnyside, Formation, or a contracted laboratory. External audits may be performed by the Lead Agency or supporting agencies. Procedures used to conduct internal and external audits shall be consistent with those described in *EPA Guidance on Technical Audits and Related Assessments* (EPA QA/G-7; EPA, 2000).

Performance and systems audits of field and laboratory data collection and reporting procedures are described in this section. Data assessments, such as data verification and validation, were presented in Section 4.0.

### 5.1 Field Performance and System Audits

At a minimum, Formation's QA Manager, or designee, shall conduct an onsite systems and performance audit of field sampling practices during the first two weeks of field data collection activities. Any non-conformances observed in the audit shall be documented and resolved. Additional systems audits or surveillance may be conducted during the remaining field investigations at the discretion of the Formation Project Manager or Formation QA Manager. At least one field audit per field season is recommended.

#### 5.1.1 Internal Field Audits

Internal audits of field activities including sampling and field measurements, will be conducted by the Formation QA Manager, or designee. These audits will verify that procedures established in the Work Plan and QAPP, including referenced SOPs (Appendix B of the Work Plan), are being followed.

The internal field audits (systems and performance audits) will include examination of field measurement and sampling records and field instrument operating records; sample collection, handling, decontamination, and packaging activities; and documentation of sampling activities in compliance with the established procedures for each field activity audited. Follow-up audits may be conducted to correct deficiencies, and to verify that QA procedures are maintained throughout the investigation. The results of field audits will be documented. The completed field audit report will be kept on file by the Formation QA Manager. After a field audit is conducted, the results of the audit will be shared by the auditor with the field teams prior to additional sampling to enhance sampling performance where applicable.

Findings of these audits will be summarized in an audit report that is given to the Formation Project Manager, Field Investigations Manager, and appropriate Field Supervisor in charge of the audited activities. The audited party will submit a reply addressing each finding cited in the report, the corrective action (if necessary) to be taken, and a schedule for implementation. The Field Investigations Manager is responsible for ensuring that corrective actions are taken.

### **5.1.2 External Field Audits**

External field audits may be conducted by representatives from the Agencies. External field audits may be conducted at any time during the field operations. These audits may or may not be announced and are at the discretion of the Agencies.

External field audits will be conducted according to the field activity information presented in the field SOPs or in the sampling procedures outlined in the Work Plan. Results of the external field audit may document the need for a change to procedures in the Work Plan and/or QAPP and result in the need for an amendment to the Work Plan and/or QAPP.

## **5.2 Laboratory Performance and Systems Audits**

### **5.2.1 Internal Laboratory Audits**

The internal laboratory audit will be conducted by the QA Officer at each laboratory utilized for the investigation. Audits will be performed in accordance with the laboratory's Quality Management Plan.

The internal laboratory system audits will be conducted on an annual basis while the internal lab performance audits will be conducted on a quarterly basis, or as specified in the laboratory's Quality Management Plan.

The internal laboratory system audits will include an examination of laboratory documentation on sample receiving, sample log-in, sample storage, COC procedures, sample preparation and analysis, instrument operating records, etc. The performance audits will involve preparing blind QC samples and submitting them along with project samples to the laboratory for analysis throughout the project. The QA Officer from each laboratory utilized for this investigation will evaluate the analytical results of these blind performance samples to ensure the laboratory maintains acceptable QC performance.

### **5.2.2 External Laboratory Audits**

An external laboratory audit may be conducted by representatives from the Agencies at any time. An external laboratory audit may be conducted prior to the initiation of the sampling and

analysis activities. These audits may or may not be announced, may be conducted at any time and are at the discretion of the Agencies.

External laboratory audits will include (but not be limited to) review of laboratory analytical procedures, laboratory on-site audits, and/or submission of performance evaluation samples to the laboratory for analysis. Typically, the external laboratory audit will be conducted in the lab so that the staff may be questioned regarding laboratory procedure. A recently produced sample data package will be compared with their SOP to ensure compliance with applicable standards.

### **5.3 Corrective Actions**

Corrective action is the process of identifying, recommending, approving and implementing measures to counter unacceptable procedures or out-of-QC performance which can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation and data assessment.

Nonconforming equipment, items, activities, conditions and unusual incidents that could affect data quality and attainment of the project's quality objectives will be identified, controlled and reported in a timely manner. For the purpose of this QAPP, a nonconformance is defined as a malfunction, failure, deficiency, or deviation that renders the quality of an item unacceptable or indeterminate in meeting the project's quality objectives.

Corrective action in the laboratory may occur prior to, during and after initial analyses. If the analytical results from laboratory QC samples fall outside of the measurement performance criteria, the laboratory should initiate corrective actions immediately. If the laboratory cannot correct the situation that caused the nonconformance and an out-of-control situation continues to occur or is expected to occur, then the laboratory will immediately contact the Formation QA Manager and request instructions regarding how to proceed with sample analyses. A number of conditions such as broken sample containers, multiple phases, low/high pH readings and potentially high concentration samples may be identified during sample log-in or just prior to analysis. Following consultation with lab analysts and section leaders, it may be necessary for the Laboratory QA Manager to approve the implementation of corrective action. These conditions may include dilution of samples, additional sample extract cleanup, automatic re-injection/reanalysis when certain QC criteria are not met, etc.

Completion of any corrective action should be evidenced by data once again falling within prescribed measurement performance criteria. If an error in laboratory procedures or sample collection and handling procedures cannot be found, the results will be reviewed by the Formation QA Manager and Formation Project Manager to assess whether reanalysis or resampling is required.

Any corrective actions taken will be documented in writing by either the Laboratory QA Manager or the Formation QA Manager and reported to the Formation Project Manager and EPA. Corrective action records will be included in the program's quality records.

#### **5.4      Corrective Action during Data Validation and Data Assessment**

The Formation QA Manager may identify the need for corrective action during either the data validation or data assessment. Potential types of corrective action may include re-sampling by the field team, reanalysis of samples by the laboratory, or re-submission of data packages with corrected clerical errors. The appropriate and feasible corrective actions are dependent upon the ability to mobilize the field team and whether the data to be collected is necessary to meet the required QA objectives (e.g., the holding time for samples is not exceeded, etc.). Corrective actions of this type will be documented by the Formation QA Manager.

#### **5.5      Quality Assurance Reports to Management**

The deliverables associated with the tasks identified in the Work Plan will contain QA discussions in which data quality information collected during the task is summarized. Those reports will be the responsibility of the Formation Project Manager and QA Manager.

The QA discussions will contain, on a routine basis, the results of field and laboratory audits, information generated on the achievement of specific DQOs and a summary of any corrective actions that were implemented and their immediate results on the project. Detailed references to any QAPP modifications will also be highlighted.

## **6.0 QAPP REFERENCES**

- EPA, 2000. Guidance on Technical Audits and Related Assessments, EPA QA/G-7.
- EPA, 2002. Guidance for Quality Assurance Project Plans EPA QA/G-5. EPA 240-R-02-009. December.
- EPA, 2004. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. EPA 540-R-04-004. October.
- EPA, 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4, EPA/240/B-06/001. February.
- EPA, 2009. EPA Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use. EPA 540-R-08-005. January.
- Kimball, B.A., Runkel, R.L., and Walton-Day, K., 2010. An Approach to Quantifying Sources, Seasonal Change, and Biogeochemical Processes Affecting Metal Loading in Streams: Facilitating Decisions for Remediation of Mine Drainage. *Applied Geochemistry* 25 (2010) 728-740.

**QUALITY ASSURANCE PROJECT PLAN TABLES**

**Table 2-1**  
**Precision, Accuracy and Completeness Calculation Equations**

Characteristic	Formula	Symbols
<b>Precision</b> (as relative percent difference, RPD)	$RPD = \frac{\sqrt{x_i - x_j}}{\frac{2}{\sum_{i=1}^n x_i}} \times 100$	$x_i, x_j$ : replicate values of $x$
<b>Precision</b> (as relative standard deviation, RSD, otherwise known as coefficient of variation)	$RSD = \frac{s}{\bar{x}} \times 100$	$s$ : sample standard deviation $\bar{x}$ : sample mean
<b>Accuracy</b> (as percent recovery, R, for samples without a background level of the analyte, such as reference materials, laboratory control samples, and performance evaluation samples)	$R = \frac{x}{t} \times 100$	$x$ : sample value $t$ : true or assumed value
<b>Accuracy</b> (as percent recovery, R, for measurements in which a known amount of analyte, a spike, is added to an environmental sample)	$R = \frac{x_s - x}{t} \times 100$	$x_s$ : value of spiked sample $x$ : value of unspiked sample $t$ : true or assumed value
<b>Completeness</b> (as a percentage, C)	$C = \frac{n}{N} \times 100$	$n$ : number of valid data points produced $N$ : total number of samples taken

Table 2-2

## Summary of Calibration and QC Procedures for EPA Method 200.8 (ICPMS)

Quality Control Check	Minimum Frequency	Lab Acceptance Criteria	Corrective Action/Lab Flagging Criteria
Sample preservation and holding time	Not applicable	Sample holding time is 180 days for aqueous samples preserved to pH < 2 with nitric acid.	Laboratory will note sample condition on receipt and notify client if criteria are not met.
AMU Check Tune	Prior to initial calibration solution as specified by lab's standard operating procedure (SOP).	Mass calibration < 0.1 amu from the true value; Stability: RSD < 5% for at least five replicate analyses. Peak resolution < 0.75 AMU at 5% peak height.	Retune instrument then reanalyze tuning solution.
Initial calibration (ICAL) for all target analytes (minimum one standard and a blank)	Daily initial calibration prior to sample analysis.	Calibration blank plus 4 non-zero standards. ICAL must be repeated for each batch unless CCV is used for continuing calibration. If the correlation coefficient for the element of interest is not greater than 0.995, then the instrument must be recalibrated and all of the associated samples for that element must be reanalyzed.	Correct problem then repeat initial calibration.
Initial Calibration Verification (ICV)	Immediately after ICAL, before beginning a sample run and from a second source.	All analytes within $\pm$ 10% of expected value.	Rerun ICV. If that fails, correct problem and repeat ICAL.
Initial Calibration Blank (ICB)	Immediately after ICV.	< 2.2X the Method Detection Limit (MDL) for dissolved 200.8 analyses or < 3X the MDL of the associated analyte.	Recalibrate if ICB is outside of acceptance criteria. Reanalyze all associated samples that are < 10X the blank and > zero since the last compliant CCB.
Continuing Calibration Verification (CCV)	After every 10 samples and at the end of the analysis sequence.	The analyte concentration within $\pm$ 10% of expected value	Correct problem then repeat CCV and reanalyze all samples since last successful CCV. If CCV recovery was high, "U" samples can be qualified and passed.
Continuing Calibration Blank (CCB)	Immediately after ICB, after every 10 samples, and at the end of the analytical sequence (after every 20 samples for dissolved analyses)	< 3X MDL	Correct problem then reanalyze calibration blank and previous 10 samples. Reanalyze all associated samples that are < 10X the blank and > zero since the last compliant CCB.
Laboratory Reagent Blank	One per analytical batch of 20 or fewer samples of the same matrix	< 2.2X MDL	Correct problem and reanalyze. Recalibrate if ICB is outside of acceptance criteria.
Laboratory Fortified Blank (LFB)	One LFB per analytical batch of 20 or fewer samples	85-115%	Correct problem then reanalyze. If still out, re-prepare and reanalyze the LFB and all samples in the preparation batch. If the LFB recovery is high, "U" samples may be qualified and passed.
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One MS/MSD per every 10 samples per matrix - not to be performed using a field blank.	Percent recovery should be within $\pm$ 30% and Relative Percent Difference (RPD) should be < 20%. If sample is spiked post digestion, percent recovery should be $\pm$ 15%. MS/MSD recoveries are not applicable if the sample concentration is >4x the spike concentration.	Qualify associated sample results
Field duplicate sample	1 field duplicate per every 20 samples per matrix	Not applicable	Not applicable
Internal Standards (IS)	Every sample; internal standards as specified by method and lab's SOP.	60% - 125% of intensity in the calibration blank.	Dilute by a factor of two and re-analyze. If IS recoveries still out, report undiluted results.
Concentrations between the MDL and CRQL	All samples	Not applicable	Qualify to indicate value is between MDL and CRQL..

Note that specific QC procedures may vary based on the laboratory that performs the analyses.

AMU - Atomic Mass Unit

CRQL - Contract Required Quantitation Limit. May be referred to as "PQL" - Practical Quantitation Limit or "RL" - Reporting Limit.

ppb - parts per billion

RSD - Relative Standard Deviation

Table 2-3

## Summary of Calibration and QC Procedures for EPA Method 200.7 (ICP)

Quality Control Check	Minimum Frequency	Lab Acceptance Criteria	Corrective Action/Lab Flagging Criteria
Sample preservation and holding time	Not applicable	Sample holding time is 180 days for aqueous samples preserved to pH ≤ 2 with nitric acid.	Laboratory will note sample condition on receipt and notify client if criteria are not met.
Initial calibration (ICAL) for all target analytes (minimum one standard and a blank)	Daily initial calibration prior to sample analysis	Calibration blank plus 1 or more non-zero standards. When 3 or more points are used, the criteria is $r^2 > 0.995$ .	Correct problem then repeat initial calibration.
Initial Calibration Verification (ICV)	After ICAL, before beginning a sample run (at a concentration other than used for calibration and from a second source)	All analytes within $\pm 5\%$ of expected value. When 3 or more points are used, the criteria is $r^2 > 0.995$ .	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.
Initial Calibration Blank (ICB)	After ICV	< 3X Method Detection Limit (MDL)	Correct problem and reanalyze. Sample values > 10X ICB may be accepted and qualified if ICB fails high.
Practical Quantitation Verification (PQV)	Daily, after ICAL and before samples are run.	The analyte concentrations within $\pm 30\%$ of expected value.	Correct problem then reanalyze.
Spectral Interference Check Sample	Immediately after PQV.	Recovery must be within $\pm 20\%$ of expected value.	Correct problem and reanalyze.
Continuing Calibration Verification (CCV)	After every 10 samples and at the end of the analysis sequence (at a mid-calibration range concentration).	The analyte within $\pm 10\%$ of expected value	Correct problem then repeat CCV and reanalyze all samples since last successful CCV. Samples < MDL may be accepted and qualified if CCV fails high.
Continuing Calibration Blank (CCB)	Immediately after CCV and after every 10 samples, and at end of the analytical sequence.	<3X MDL	Correct problem then reanalyze calibration blank and previous 10 samples. Sample values > 10X CCB or < MDL may be accepted and qualified if CCB fails high.
Laboratory Reagent Blank (LRB) / Method Blank	One per analytical batch of 20 or fewer samples of the same matrix.	< 2.2X MDL	Correct problem and reanalyze. Sample values > 10X LRB or < MDL may be accepted and qualified LRB fails high.
Laboratory Fortified Blank (LFB)/Laboratory Control Sample (LCS)	One LFB per analytical batch of 20 or fewer samples	85-115%	Correct problem then reanalyze. If still out, re-prepare and reanalyze the LFB and all samples in the preparation batch. If LFB fails high, samples < MDL may be accepted and appropriately qualified.
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One MS/MSD per every 10 samples per matrix - field blanks may not be used.	Percent recovery should be within $\pm 30\%$ and Relative Percent Difference (RPD) should be < 20%. If sample is spiked post digestion, percent recovery should be $\pm 15\%$ . MS/MSD recoveries are not applicable if the sample concentration (used for spiking) is >4x the spike concentration.	Flag associated sample results. If the RPD $\geq 20\%$ samples must be reprepped and reanalyzed. Ag must have passing RPD in digested samples.
Field duplicate sample	1 field duplicate per every 20 samples per matrix	Not applicable	Not applicable
Concentrations between the MDL and CRQL	All samples	Not applicable	Qualify to indicate value is between MDL and CRQL.

Note that specific QC procedures may vary based on the laboratory that performs the analyses.

CRQL - Contract Required Quantitation Limit. May be referred to as "PQL" - Practical Quantitation Limit or "RL" - Reporting Limit.

**Table 2-4**

**Summary of Calibration and QC Procedures for Method SM2320B**

Quality Control Check	Minimum Frequency	Lab Acceptance Criteria	Corrective Action/Lab Flagging Criteria
Sample preservation and holding time	Not applicable	Sample collected and sent to lab at 0 to 6°C and analyzed within 14 days of collection.	Laboratory will note sample condition on receipt and notify client if criteria are not met.
Practical Quantitation Verification	One per analytical batch	within ± 50%	Correct problem prior to continuing analysis. Otherwise, recalibrate system.
Prep Blank Water (PBW)/Method Blank	1 per batch of 20 or less samples	< PQL	All samples affected by high method blanks (sample < 10X the highest (PBW) must be qualified accordingly.
Laboratory Control Standard Water (LCSW)	Analyze 1 LCSW at the beginning of the run, one after every 20 samples (or less) and one at the end of the analysis.	90-110% recovery	Correct problem then reanalyze.
Analytical Duplicate	One analytical duplicate per every 10 client samples - field blanks may not be used.	RPD ≤ 20%	If RPD above control limit, reanalyze associated samples.
Field duplicate sample	1 field duplicate per every 20 samples per matrix	Not applicable	Not applicable

Note that specific QC procedures may vary based on the laboratory that performs the analyses.

PQL - Practical Quantitation Limit

RPD - Relative percent difference

Table 2-5

## Summary of Calibration and QC Procedures for Method 300.0 (IonChromatography) - Aqueous Samples

Quality Control Check	Minimum Frequency	Lab Acceptance Criteria	Corrective Action/Lab Flagging Criteria
Sample preservation and holding time	Not applicable	Sample collected and sent to lab unpreserved at 0 to 6°C . Samples analyzed 28 days from collection.	Laboratory will note sample condition on receipt and notify client if criteria are not met.
Calibration Standards	Daily(first batch of the day) or when ICV/CCV fail	$r^2 \geq 0.995$	Reanalyze suspect calibration standard. If criteria still not met, then remake standards and recalibrate the instrument.
Initial Calibration Verification (ICV)	One per analytical batch. Immediately following calibration.	Aqueous: 90-110%	If ICV does not meet criteria, retest one time, if problem persists, recalibrate the instrument.
Continuing Calibration Verification (CCV)	Before beginning a sample run if using a continue calibration, 1 every 10 client samples and 1 at the end of each batch.	Aqueous: 90-110%	Rerun CCV to see if within limits. If both attempts fail, recalibration or two consecutive passing CCVs are required.
Initial Calibration Blanks (ICB)	Immediately following calibration after ICV.	< +/-3X (Method Detection Limit) MDL	Rerun ICB to see if it meets criteria. If not, then recalibrate instrument.
Continuing Calibration Blank (CCB)	Before beginning a sample run, after the CCV, if using a continuing calibration, after every 10 client samples, and at end of the analytical sequence	< +/-3X MDL	Correct problem then reanalyze. Samples < MDL can be accepted and reported with the appropriate qualifier if bracketing CCB(s) fails high.
Laboratory Fortified Blank (LFB)/Laboratory Control Sample (LCS)	One per every 20 or fewer client samples.	90-110%	One re-test OK, then, if not within limits, reanalyze all samples. Recalibrate if necessary.
Analytical Spike (Matrix Spike)	One per every 10 analytical samples	90-110%	If instrument QC for other QC samples is within limits, sample results are qualified. If other instrument QC is out of limits, reanalyze samples.
Analytical Duplicate	One per every 10 analytical samples	RPD < 20% /for duplicate concentrations > 10 times MDL	Reanalyze and if within limits, then no impact. If reanalysis results not within limits, then reanalyze associated samples. If duplicate results < 10X MDL, qualify sample results. If the LFB & associated instrument QC pass, then accept qualify the data.
Field duplicate sample	1 field duplicate per every 20 samples per matrix	Not applicable	Not applicable

Note that specific QC procedures may vary based on the laboratory that performs the analyses.

**Table 3-1**  
**Requirements for Sample Preservation and Preparation Techniques, Sample Volumes, and Holding Times**

Parameter	Laboratory Analytical Method	Sample Preparation Method	Preservative <sup>1</sup>	Minimum Sample Volume	Bottle Type	Maximum Holding Time (Days)
Metals and metalloids and Hardness	EPA 200.7 and 200.8 (ICP and ICP-MS) and SM2340B (hardness) by calculation	Field filtered (dissolved), Hot Plate Digestion 200.2 (200.7 and 200.8)	HNO <sub>3</sub>	250 mL	HDPE	180
		Unfiltered (total); Hot Plate Digestion 200.2 (200.7 and 200.8)	HNO <sub>3</sub>	250 mL	HDPE	180
Chloride	EPA 300.0	None	None	250 mL	HDPE	28
Bromide	EPA 300.0	None				
Fluoride	EPA 300.0	None				
Sulfate	EPA 300.0	None	ice < 6°C but >0°C	500 mL	HDPE	14
Alkalinity <sup>2</sup>	SM2320B	None				
TSS	SM2540D	None				
TDS	SM2540C	None	None	7	7	7

Notes

1. In addition to the preservation listed, all samples shall be placed in a cooler with ice that is maintained at temperatures < 6°C but >0°C (40 CFR 136) following collection and during shipment to the lab.

2. The holding time for alkalinity is 14 days.

Table 3-2

## Achievable Laboratory Limits and Regulatory Standards Surface Water Parameters

Target Analyte	Laboratory Analytical Method	Laboratory Method Detection Limit ( $\mu\text{g/L}$ )	Laboratory Reporting Limit <sup>2</sup> ( $\mu\text{g/L}$ )	Colorado Water Quality Standard <sup>1</sup> ( $\mu\text{g/L}$ )	
				Dissolved	Total Recoverable
<b>Laboratory Parameters</b>					
<b>Metals (total and dissolved)</b>					
Aluminum	200.8	1	5	--	750 ac/ch
Arsenic	200.8	0.2	1	340 ac	100 ch
Barium	200.8	0.5	2.5	--	--
Cadmium	200.8	0.1	0.5	See Table 5-2 of Work Plan	--
Calcium	200.7	100	500	--	--
Chromium	200.8	0.5	2	$\text{Cr}^{\text{III}} \text{ TVS}^2 = 183 \text{ ac / 24 ch}$	$\text{Cr}^{\text{III}} = 100 \text{ ch}$
Cobalt	200.8	0.05	0.25	--	--
Copper	200.8	0.5	2.5	$\text{TVS}^2 = 3.6 \text{ ac / 2.7 ch}$	--
Iron	200.7	20	50	--	1000 ch
Lead	200.8	0.1	0.5	$\text{TVS}^2 = 14 \text{ ac / 0.5 ch}$	--
Lithium	200.7	8	40	--	--
Magnesium	200.7	200	1000	--	--
Manganese	200.8	0.5	2.5	See Table 5-2 of Work Plan	--
Molybdenum	200.8	0.5	2.5	--	160 ch
Nickel	200.8	0.6	3	$\text{TVS}^2 = 145 \text{ ac / 16 ch}$	--
Potassium	200.7	200	1000	--	--
Silica	200.7	214	1070	--	--
Silver	200.8	0.05	0.25	$\text{TVS}^2 = 0.19 \text{ ac / 0.01 ch trout / 0.03 ch}$	--
Sodium	200.7	200	1000	--	--
Strontium	200.7	5	25	--	--
Vanadium	200.8	0.2	1	--	--
Zinc	200.8	2	5	See Table 5-2 of Work Plan	--
<b>Anions</b>					
Bromide	300.0	50	250	--	--
Chloride	300.0	500	2,500	--	--
Fluoride	300.0	50	250	--	--
Sulfate	300.0	500	2,500	--	--
<b>Misc.</b>					
Alkalinity	SM 2320B	2,000	20,000	--	--
Hardness	SM2340B	1500	7500	--	--
TSS	SM2540D	10,000	20,000	--	--
TDS	SM2540C	5,000	20,000	--	--

## Notes:

1. Colorado Department of Public Health and Environment (CDPHE), 2014. Standards are stated as dissolved phase (e.g., filtered with a 0.45 micron filter). If there is more than one standard then the lowest standard was used.
2. TVS = table value standard. Calculated using a mean hardness of 25 mg/L calcium carbonate CDPHE (2013)
3. Laboratory reporting limit (RL) is equivalent to the practical quantitation limit (PQL)
4. TSS = Total suspended sediments
5. TDS = Total dissolved solids
6. ac = acute
7. ch = chronic

**Table 3-3**  
**Required Frequencies for Field QC Samples**

Sample Type	Analytes	Analysis Methods	Field Duplicate	Equipment Rinsate Blank	MS/MSD	Filter Blank
Water	Metals and Metalloids (Table 3-2)	200.7 200.8 SM2340B by calculation	1 / 20 samples	1/20 samples	1/20 samples Extra volume - 500ml bottle Unfiltered, Unpreserved	1 per sampling event
	Hardness					None
	Chloride, Bromide, Sulfate, Fluoride	300	1 / 20 samples	1/20 samples		None
	Alkalinity	SM2320B	1 / 20 samples	NA		None
	Total Dissolved Solids	SM2540C	1 / 20 samples	NA		None
	Total Suspended Solids	SM2540D	1 / 20 samples	NA		None

**Table 3-4**  
**Required Frequencies for Laboratory QC Analyses**

Sample Type	Analytes	Analysis Methods	Method Blank*	Laboratory Fortified Blank/Laboratory Control Sample	Analytical Duplicate	Matrix Spike/Matrix Spike Duplicate Pair
Water	Metals and Metalloids (Table 3-2) Hardness	200.7 200.8 SM2340B by calc	1/20	1/20	NA	1 pair/ 20 samples
	Chloride, Bromide, Sulfate, Fluoride	300.0	1/10 <sup>1</sup>	1/20	1/10	1/10 <sup>2</sup>
	Alkalinity	SM2320B	1/20	NA	1/10	NA
	Total Dissolved Solids	SM2540C	1/20	NA	1/10	NA
	Total Suspended Solids	SM2540D	1/20	NA	1/10	NA

NA - Not Applicable

<sup>1</sup> A calibration blank instead of a method blank because the samples aren't prepared but are run directly per the method.

<sup>2</sup> Called an analytical spike sample for this method (which is a spiked site sample) but a spike duplicate of this sample is not run per the method.

**Table 3-5**  
**EDD Specifications for the Laboratory**

Lab EDD Fields	Description
COCSampleID	Field sample identification number
SampleDate	Date sample collected
SampleTime	Time sample collected
PreparationMethod	Preparation method number
AnalyticalMethod	Analytical method number
Matrix	Sampling matrix
TorDAnalysis	Total or dissolved analysis (filtered or unfiltered sample)
Basis	Wet/dry basis for analyte reporting
Analyte	Parameter label
Result	Measured concentration
Units	Units of measure
DetLimit	Detection limit
DetLimitType	Detection limit type (e.g., MDL or IDL)
ReportingLimit	Reporting limit
LabQualifier	Parameter value qualifier
Dilution	Dilution factor
LabName	Lab name
SDGNumber	Lab Sample Delivery Group (SDG) number
LabSampleID	Lab sample identification number
ReceivedDate	Date sample received by laboratory
AnalysisDate	Data sample analyzed by laboratory
QQualifier	EPA qualifier (e.g., H or D)
CAS#	Compound name
Validation Qualifier <sup>1</sup>	Qualifier applied based on data validation (J+, UJ, etc)
Validation Qual Reason <sup>1</sup>	If EPA codes not used, a written explanation of the reason qualified
Val Status <sup>1</sup>	Explains if the data has been validated or not
Val Person <sup>1</sup>	Validation contractor and validator (initials)
Val Protocol <sup>1</sup>	Document validator referred to for validation procedures (QAPP or NFG, etc.)
Val Notes <sup>1</sup>	Additional information pertaining to a result

EDD - Electronic data deliverable

IDL - Instrument detection limit

MDL - Method detection limit

SDG - Sample delivery group

<sup>1</sup> Fields to be added by Validator

## **Appendix C – SOPs**

**All Applicable SOPs for the High-Flow Surface Water  
Investigation**

## **STANDARD OPERATING PROCEDURE No. 1**

### **FIELD DOCUMENTATION**

#### **1.0 SCOPE AND APPLICABILITY**

The following Standard Operating Procedure (SOP) describes the protocol for documenting field monitoring activities. The procedures presented herein are intended to be general in nature and are applicable when referenced by site-specific or project-specific planning documents. Appropriate modifications to the procedures may be made to accommodate project-specific protocols when approved in writing or via email by the Project Manager or detailed in a project work plan, sampling plan, or quality assurance project plan.

The objective of this SOP is to establish a consistent method and format to document daily field activities. The resultant field notes and records are intended to provide sufficient information that can be used to recreate the field activities and the collection of environmental data.

#### **2.0 BASIS FOR METHODOLOGY**

The methods and procedures described in this SOP were developed from these sources:

- ANSI/ASQC E-4 (1994) American National Standards Institute/American Society for Quality Control Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs.
- ASTM D 6089 (2010) American Society for Testing and Materials (ASTM) ASTM D 6089 Standard Guide for Documenting a Ground-Water Sampling Event.
- EPA QA/G6 (2007) U.S. Environmental Protection Agency Guidance for Preparation of Standard Operating Procedures (SOPs). EPA/600/B-07/001. Office of Environmental Information, Washington, DC, April.
- EPA QA/G5 (2002) U.S. Environmental Protection Agency EPA Guidance for Quality Assurance Project Plans. EPA/240/R-02/009. Office of Environmental Information, Washington, DC, December.

### **3.0 PROCEDURES**

#### **3.1 Daily Field Activities**

The field representative actually performing the environmental monitoring or sampling will record all field activities in the field notebook for each day of field work.

Documentation will include:

- A. Project identification;
- B. Date;
- C. Time on job (beginning and ending time);
- D. Weather conditions;
- E. Activity description;
- F. List of personnel and visitors on site;
- G. Safety equipment used and monitoring performed;
- H. Waste storage inventory (if any);
- I. Chronological record of activities and events;
- J. Comments and variances from project work plan;
- K. Content of telephone conversations;
- L. Calibration parameters; and
- M. Signature of the field representative.

The field representative will document all details that would be necessary to recreate the day's activities and events at a later time. The field notebook will be used to document field activities and information that may not be specified on other field record forms. Other activity-specific documentation requirements to be recorded on field record forms are discussed in the Standard Operating Procedure for each activity.

## **4.0 DOCUMENTATION**

### **4.1 Field Record Forms**

In addition to the field notebook, field personnel will complete specific field record forms (which may be in paper or electronic format) applicable to the field activities being conducted. The procedures for completion of activity-specific field record forms are presented in the applicable Standard Operating Procedures. Additional field record forms and applicable procedures may be created for project-specific activities, as necessary.

### **4.2 Records Management**

All original field forms and copies of field notebooks will be filed with the appropriate project records in the project files. Specific field record forms filled out using an electronic device will be printed and filed with the appropriate project records.

## **5.0 QUALITY ASSURANCE/QUALITY CONTROL**

All completed field forms will be reviewed by the Project Manager or project-designated reviewer. Any necessary corrections will be made in pen with a single-line strike out that is initialed and dated.

## **6.0 REFERENCES**

American National Standards Institute/American Society for Quality Control, 1994. Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs. ANSI/ASQC E-4.

American Society for Testing and Materials (ASTM), 2010. ASTM D 6089-97. Standard Guide for Documenting a Ground-Water Sampling Event. American Society for Testing and Materials available online at <http://www.astm.org/>

U.S. Environmental Protection Agency (USEPA), 2007. EPA QA/G6, Guidance for Preparing Standard Operating Procedures (SOPs). EPA/600/B-07/001. Office of Environmental Information, Washington, DC, April. Available online at <http://www.epa.gov/QUALITY/cs-docs/g6-final.pdf>

U.S. Environmental Protection Agency (USEPA), 2002. EPA QA/G5, EPA Guidance for Quality Assurance Project Plans. EPA/240/R-02/009. Office of Environmental

Information, Washington, DC., December.  
<http://www.epa.gov/QUALITY/as-docs/g5-final.pdf>

Available online at

## **STANDARD OPERATING PROCEDURE No. 2**

### **SAMPLE CUSTODY, PACKAGING, AND SHIPMENT**

#### **1.0 SCOPE AND APPLICABILITY**

The following Standard Operating Procedure (SOP) describes the protocol for sample custody and packaging and shipment of samples. The procedures presented herein are intended to be general in nature and are applicable when referenced by site-specific or project-specific planning documents. Appropriate modifications to the procedures may be made when approved in writing or via email by the Project Manager.

This SOP applies to any liquid or solid sample that is being transported by the sampler, a courier, or an overnight delivery service.

#### **2.0 BASIS FOR METHODOLOGY**

The methods and procedures described in this SOP were developed from these sources:

- 49 CFR 173. Shippers – Shippers – General Requirements for Shipping. United States Code of Federal Regulations available online at <http://www.gpoaccess.gov/cfr/index.html>
- 49 CFR 178. Specifications for Packaging. United States Code of Federal Regulations available online at <http://www.gpoaccess.gov/cfr/index.html>
- ASTM D 4220-95 (2000). Standard Practices for Preserving and Transporting Soil Samples, American Society for Testing and Materials available online at <http://www.astm.org/>
- ASTM D 4840-99 (2010). Standard Guide for Sampling Chain-of-Custody Procedures. American Society for Testing and Materials available online at <http://www.astm.org/>

### 3.0 PROCEDURES

The objectives of this packaging and shipping SOP are to minimize the potential for sample breakage, leakage, or cross contamination; to provide for preservation at the proper temperature; and to provide a clear record of sample custody from collection to analysis.

#### 3.1 Packaging Materials

The following is a list of materials that will be needed to facilitate proper sample packaging:

- Chain-of-Custody (COC)/Request for Analysis (RA) forms;
- Analyte List;
- Coolers (insulated ice chests) or other shipping containers as appropriate to sample type;
- Transparent packaging tape;
- Duct tape or similar (for sealing cooler drain);
- Zip-lock type bags (note: this is used as a generic bag type, not a specific brand name);
- Large garbage bags;
- Protective wrapping and packaging material;
- Contained ice (packaged and sealed to prevent leakage when melted) or "Blue Ice"; and
- Chain-of-Custody seals.

#### 3.2 Sample Custody from Field Collection to Laboratory

After samples have been collected, they will be maintained under chain-of-custody procedures. These procedures are used to document the transfer of custody of the samples from the field to the designated analytical laboratory. The same chain-of-custody procedures will be used for the transfer of samples from one laboratory to another, if required.

The field sampling personnel will complete a COC/RA form and provide an Analyte List for each separate container of samples to be shipped or delivered to the laboratory for chemical or physical (geotechnical) analysis. Information contained on the form will include:

1. Project identification;
2. Date and time of sampling;
3. Sample identification;
4. Sample matrix type;
5. Sample preservation method(s);
6. Number and types of sample containers;
7. Sample hazards (if any);
8. Requested analysis(es);
9. Method of shipment;
10. Carrier/waybill number (if any);
11. Signature of sampling personnel;
12. Name of Project Manager;
13. Signature, name and company of the person relinquishing and the person receiving the samples when custody is being transferred;
14. Date and time of sample custody transfer;
15. Condition of samples upon receipt by laboratory; and
16. Chain of Custody identification number.

The samples will be carefully packaged into shipping containers/ice chests.

The sampling personnel whose signature appears on the COC/RA form is responsible for the custody of a sample from the time of sample collection until the custody of the sample is transferred to a designated laboratory, a courier, or to another employee for the purpose of transporting a sample to the designated laboratory. A sample is

considered to be in their custody when the custodian: (1) has direct possession of it; (2) has plain view of it; or (3) has securely locked it in a restricted access area.

Custody is transferred when both parties to the transfer complete the portion of the COC/RA form under "Relinquished by" and "Received by." Signatures, printed names, company or organization names, and date and time of custody transfer are required. Upon transfer of custody, the sampling personnel who relinquished the samples will retain a copy of the COC/RA form.

### **3.3 Sample Custody within Laboratory**

The designated laboratory will assume sample custody upon receipt of the samples and COC/RA form. Sample custody within the analytical laboratory will be the responsibility of designated laboratory personnel. The laboratory will document the transfer of sample custody and receipt by the laboratory by signing the correct portion of the COC/RA form. Upon receipt, the laboratory sample custodian will note the condition of the samples, by checking the following items:

1. Agreement of the number, identification and description of samples received by comparison with the information on the COC/RA form; and
2. Condition of samples (any bottle breakage; leakage, cooler temperature, etc.).

If any problems are discovered, the laboratory sample custodian will note this information on the "Laboratory Comments/Condition of Samples" section of the COC/RA form, and will notify the sampling personnel or Project Manager immediately. The Project Manager will decide on the final disposition of the problem samples.

The laboratory will retain a copy of the COC/RA form and return an electronic copy to the originator with the final laboratory report of analytical results. The original of the COC/RA form will be retained as part of the permanent documentation in the project file. A record of the history of the sample within the laboratory containing sample status and storage location information will be maintained in a logbook, or a computer sample tracking system, at the laboratory. The following information will be recorded for every sample access event:

1. Sample identification;
2. Place of storage;
3. Date(s) and time(s) of sample removal and return to storage;
4. Accessor's name and title;
5. Reason for access; and
6. Comments/observations (if any).

The laboratory will provide a copy of the logbook or computer file information pertaining to a sample upon request.

### **3.4 Sample Custody during Inter-Laboratory Transfer**

If samples must be transferred from one laboratory to another, the same sample custody procedures described above will be followed. The designated laboratory person (sample custodian) will complete a COC/RA form and sign as the originator. The laboratory relinquishing the sample custody will retain a copy of the completed form. The laboratory receiving sample custody will sign the form, indicating transfer of custody, retain a copy, and return the original record to the originator with the final laboratory report of analytical results. The COC/RA form will be retained as part of the permanent documentation in the project file.

### **3.5 Packaging and Shipping Procedure**

All sample containers will be properly labeled and all samples will be logged on the COC/RA form in accordance with the procedures explained.

All samples will be packed in the cooler so as to minimize the possibility of breakage, cross-contamination, and leakage. Before placing the sample containers into the cooler, all sample bottle caps will be checked and tightened if necessary. A large garbage bag will be placed as a liner inside the cooler and duct tape (or similar) will be used to seal off any drain openings on the inside and/or outside of the cooler. Bottles made of breakable material (e.g., glass) will also be wrapped in protective material (e.g., bubble wrap, plastic gridding, or foam) prior to placement in the cooler. Each sample set or soil

tube liner (for a California, Shelby Tube or Split-spoon Sampler) will be placed into a zip-lock bag to protect from cross-contamination and to keep the sample labels dry. Sample containers will be placed upright in the cooler. Stacking glass sample bottles directly on top of each other will be avoided.

If required by the method, samples will be preserved to 4°C prior to the analysis. Water ice or "blue ice" will be used to keep the sample temperatures at 4°C. The ice will be placed in two zip-lock bags if the samples are to be transported by someone other than the sampler (e.g., a courier or overnight delivery service). The zip-lock bags of ice will be placed in between, on the bottom, and/or on top of the sample containers so as to maximize the contact between the containers and the bagged ice. If the sampler is transporting the samples to the laboratory shortly after sample collection, the water ice may be poured over and between the sample bottles in the cooler.

If there is any remaining space at the top of the cooler, packing material (e.g., Styrofoam pellets or bubble wrap) will be placed to fill the open space of the cooler. After filling the cooler, the garbage bag will be sealed, a copy of the COC/RA form and Analyte List will be placed in a zip-lock bag and taped to the inside of the cooler lid, the top of the cooler will be closed, and the cooler will be shaken to verify that the contents are secure. Additional packaging material will be added if necessary.

When transport to the laboratory by the sampler is not feasible, sample shipment will occur via courier or overnight express shipping service that guarantees shipment tracking and next morning delivery (e.g., Federal Express Priority Overnight or UPS Next Day Air). The same procedures will be followed to pack and fill the cooler and provide the COC/RA form and Analyte List, as if the sampler were transporting the samples to the laboratory. The cooler will be taped shut with packaging tape. Packaging tape will completely encircle the cooler, and chain-of-custody seals will be signed and placed across the front and side of the container opening.

Copies of all shipment records provided by the courier or overnight delivery service will be retained and maintained in the project file.

#### **4.0 DOCUMENTATION AND RECORDS MANAGEMENT**

Daily Field Records or a field notebook with field notes will be kept describing the packaging procedures and the method of shipment. Copies of all shipping records and chain-of-custody records will be retained in the project file.

#### **5.0 QUALITY ASSURANCE**

The Project Manager or designated reviewer will check and verify that documentation has been completed and filed per this procedure.

#### **6.0 REFERENCES**

49 CFR 173. Shippers – General Requirements for Shipments and Packagings. United States Code of Federal Regulations. Available online at <http://www.gpoaccess.gov/cfr/index.html>

49 CFR 178. Specifications for Packaging. United States Code of Federal Regulations. Available online at <http://www.gpoaccess.gov/cfr/index.html>

ASTM D 4220-95 (2000). Standard Practices for Preserving and Transporting Soil Samples, ASTM International, West Conshohocken, PA, 2000. Available online at <http://www.astm.org/>

ASTM D 4840-99 (2010). Standard Guide for Sampling Chain-of-Custody Procedures, ASTM International, West Conshohocken, PA, 2010. Available online at <http://www.astm.org/>

## **STANDARD OPERATING PROCEDURE No. 5**

### **WATER QUALITY SAMPLING**

#### **1.0 SCOPE AND APPLICABILITY**

This Standard Operating Procedure (SOP) describes the protocol to be followed during sampling of surface water. The procedures presented herein are intended to be general in nature and are applicable when referenced by site-specific or project-specific planning documents. Appropriate modifications to the procedures may be made to accommodate project-specific protocols when approved in writing or via email by the Project Manager.

The objectives of the water quality sampling procedures are to minimize changes in surface water chemistry during sample collection and to maximize the probability of obtaining a representative, reproducible surface water sample.

#### **2.0 BASIS FOR METHODOLOGY**

The methods and procedures described in this SOP were developed from these sources:

- U.S. Geological Survey (USGS) (variously dated) National Field Manual for the Collection of Water-Quality Data: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Handbooks for Water-Resources Investigations, Chapters A1-A9.
- U.S. Environmental Protection Agency (USEPA) (2003) USEPA Region 8 SOP EH-#1 Technical Standards Operating Procedure – Surface Water Sampling East Helena Site, Montana.

#### **3.0 PROCEDURES**

##### **3.1 Sample Collection**

Individual samples from surface water sampling stations will be collected as follows:

- A. Where multiple sampling stations exist along a moving water source (i.e., a creek or drainage channel), the downstream station will be sampled first. A moving water sample will be taken from the portion of the water with maximum flow at any given sampling station unless otherwise specified. If the sampling point is inaccessible from shore, the sampling personnel will enter the water from a point downstream of the sampling point, taking care not to disturb the water.
- B. A standing water sample will be taken at a point in the body of water at least three feet from the shore, if possible, or unless otherwise specified.
- C. A surface water sample will be collected according to one of the following, or similar, techniques.
  - 1. Direct Method -- Sample bottle or disposable container (e.g., cubitainer) is uncapped and inverted, submerged to the specified depth, turned upright pointing upstream, removed from the water, and then capped (if actual sample bottle used). Add preservative, if any, after sample collection.
  - 2. Dipper Method -- Sample bottle or container attached to a pole is dipped in the water, raised above the water, and then capped (if actual sample bottle used).
  - 3. Bailer Method -- An appropriate sampling bailer with a ball check valve is submerged to the desired sample depth, either directly or by suspending the bailer on a rope from a pole.
  - 4. Syringe Method (for very shallow water) -- A disposable plastic filtering syringe may be used to collect very shallow surface water without disturbing the sediment. The syringe will be disposed of after each use.
  - 5. Peristaltic Pump Method -- The sample is collected through a section of new, clean, flexible Tygon (polyvinylchloride) or silicone tubing. The tubing intake will be secured manually or by attaching weights. This procedure may be modified to collect the sample through a Teflon tube into a sample flask by running the pump on a vacuum.
  - 6. Kemmerer Bottle -- Use a properly decontaminated Kemmerer bottle. Set the sampling device so that the upper and lower stoppers are pulled away from the body, allowing water to enter the tube. Lower the pre-set sampling device to the predetermined depth. Avoid disturbing the bottom. Once at the required depth, send the weighted messenger or down the suspension line, closing the device. Retrieve the sampler and discharge the first 10-20 mL from the drain to clear water that may not be representative of the sample. Repeat as needed to collect the needed volume.

7. Van Dorn Sampler -- Set the device so that the end stoppers are pulled away from the body allowing surface water to enter the tube. Lower the sampler to the predetermined depth. Once at the required depth send the weighted messenger down the suspension line, closing the sampling device. Retrieve the sampler and decant the first 10- 20 mL from the drain to clear water that may not be representative of the sample from the valve. Repeat as needed until the required volume to fill sample bottles is collected.
  8. Bacon Bomb Sampler -- Lower the bacon bomb sampler carefully to the desired depth, allowing for the trigger to remain slack at all times. When the desired depth is reached, pull the trigger line until taught. This will allow the sampler to fill. Release the trigger line and retrieve the sampler. Decant the first 10-20 mL from the drain to clear water that may not be representative of the sample from the valve. Repeat as needed until the required volume to fill sample bottles is collected.
- D. For the direct and dipper methods, the mouth of the sample collection container will be oriented downstream. The first collected water will be used to rinse the sampling equipment. Sample bottles that do not contain preservative should be rinsed with the sample water prior to filling. Subsequent water collected will be used to fill the analytical sample bottles until all bottles are filled. Field measurement of parameters will be taken once for each sampling station at the time of sample collection. Field parameters (pH, specific conductance, temperature, dissolved oxygen (DO), oxidation-reduction potential (ORP), odor, turbidity, and/or sediment) will be measured from a separate container (instruments will not contact the analytical samples) or directly from the water body sampled downgradient of the sample collection location.
- E. To mark the exact sampling location, either: (1) a stake or pole identifying the sampling station should be placed at or near the sampling station for future identification of the location, or (2) the sample location will be recorded in a Global Positioning System (GPS) device and coordinates will be downloaded at the end of the field event. Personnel will record a brief description of the stake or pole location in relation to permanent landmarks, and the sampling location in relation to the stake or pole (example: stake is approximately 100 feet west along Markley Creek from Somersville Road, on north-side shore. Sampling point is 25 feet south of stake, in middle of Markley Creek), or the GPS coordinates of the location. Personnel will include a sketch map of the sampling station in the Surface Water Sampling Record (attached form or similar).

### 3.2 Sample Filtration

When required, a field-filtered water sample will be collected using a disposable, in-line 0.45 micron ( $\mu\text{m}$ ) filter. The water sample will be pumped through the filter attached

(polyvinylchloride) tubing, silicone tubing, or other appropriate method may be used. The filter cartridge will be rinsed according to the manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum aliquot of 100 ml of sample water prior to collection of sample into the containers. Both the filter and tubing will be disposed between samples.

### **3.3 Sample Containers and Volumes**

The sample containers will be appropriate to the analytical method and will be obtained from the water analysis laboratory or other approved source. Different containers will be required for specific groups of analytes in accordance with U.S. EPA Methods, project-specific requirements, and/or other local jurisdictional guidance. The sampler will confirm with the laboratory performing the analyses that appropriate bottleware and preservatives are used and ensure that a sufficient volume of sample is collected.

### **3.4 Sample Preservation and Storage**

If required by the project or analytical method, water samples submitted for chemical analysis will be stored at 4°C in ice-cooled, insulated containers immediately after collection. Preservation and storage methods depend on the chemical constituents to be analyzed and should be discussed with the water analysis laboratory prior to sample collection. EPA and/or other local jurisdictional requirements and/or the requirements of a project-specific plan (e.g., sampling and analysis plan, work plan, quality assurance project plan, etc.) shall be adhered to in preservation and storage of water samples.

### **3.5 Field Measurements**

Specific conductance, pH, turbidity, DO, ORP, and temperature measurements will be performed on water samples at the time of sample collection. Data obtained from these (or other) field water quality measurements will be recorded on the appropriate sampling records and/or in the field notebook. Separate aliquots of water shall be used to make field measurements (i.e., sample containers for laboratory analysis shall not be

reopened). For surface water sampling, the parameters will be measured once and recorded.

### **3.5.1 Temperature Measurement**

Temperature will be measured directly from the water source or from a separate sample aliquot. Temperature measurements will be made with a mercury-filled thermometer, bimetallic-element thermometer, multiprobe, or electronic thermometer. All measurements will be recorded in degrees Celsius (°C) after the reading has stabilized.

### **3.5.2 Turbidity**

Turbidity will be measured by using a field portable nephelometer or integrated turbidity sensor on a multi-parameter meter (e.g., YSI Sonde 6920) capable of reading down to 0.1 NTU. The instrument will be calibrated at least daily or according to the manufacturer's recommendations prior to initiating field activities and periodically throughout the day or as recommended by the instrument manufacturer. Turbidity measurements will be reported in nephelometric turbidity units (NTU).

### **3.5.3 pH Measurement**

A pH measurement will be made by dipping the probe directly into the water source or into a separate sample aliquot. Prior to measurement, the container in which the field parameter sample will be collected will be acclimated to the approximate temperature of the sample. This can be accomplished by immersing the container in water collected from the sampling location. The value displayed on the calibrated instrument will be recorded after the reading has stabilized. If the value falls outside of the calibrated range, then the pH meter will be recalibrated using the appropriate buffer solutions.

### **3.5.4 Specific Conductance Measurement**

Specific conductance will be measured by dipping the probe directly into the water source or into a separate sample aliquot. The probe must be immersed to the manufacturer's recommended depth. Specific conductance will be reported in

micromhos/cm at 25 °C . If the meter is not equipped with an automatic temperature compensation function, then the field value will be adjusted at a later time using the temperature data and the following formula:

$$SC_{25} = SC_T / [1 + \{(T - 25) \times 0.025\}]$$

where:  $SC_{25}$  = specific conductance at 25 °C  
 $SC_T$  = specific conductance measured at temperature T (°C)  
T = sample temperature (°C)

The value displayed on the calibrated instrument will be recorded after the reading has stabilized. If the value falls outside of the calibrated "range" set by the range dial on the instrument, then the range setting will be changed to a position that gives maximum definition. If the specific conductance value falls outside of the calibrated range of the conductivity standard solution, then the instrument will be recalibrated using the appropriate standard prior to measurement.

### 3.5.5 Dissolved Oxygen

Dissolved oxygen measurements taken from surface water locations should be representative of the conditions being monitored. For example, if a sample is to be collected from the middle of a stream cross-section, that is also where the DO measurement should be taken.

The dissolved oxygen probe should be fully immersed in the water body being monitored. If the DO measurement is taken from a stream, the probe should be elevated above the stream bed to minimize disturbance of channel sediments. If DO measurements are taken from a water body that is not flowing, the probe should be slowly raised and lowered so that water is moving past the DO probe membrane.

Dissolved oxygen readings should be recorded after allowing sufficient time for the probe to equilibrate and the readings to stabilize. For surface water measurements, the DO reading will typically stabilize as soon as the probe has equilibrated. The value displayed on the calibrated instrument will be recorded after the reading has stabilized.

### **3.5.6 Oxidation-Reduction Potential**

Oxidation-Reduction potential will be measured by dipping the probe directly into the water source or into a separate sample aliquot. The probe must be immersed to the manufacturer's recommended depth. ORP will be reported in mV. Readings should be recorded after allowing sufficient time for the probe to equilibrate and the readings stabilize.

### **3.5.7 Equipment Calibration**

Equipment used to measure field parameters will be calibrated in the field daily in accordance with SOP No. 31 (WATER QUALITY METER CALIBRATION) by field personnel prior to the collection of any samples

## **4.0 DOCUMENTATION**

Each sampling event for each surface water sampling station will be recorded in the field notebook and/or on a separate Surface Water Sampling Record form (in print or electronic format – see attached). The documentation should include the following:

- A. Project identification;
- B. Location identification (sampling station);
- C. Sample identification(s) (including quality control samples);
- D. Date and time of sampling;
- E. Weather conditions;
- F. Description of sampling location;
- G. Sampling method;
- H. Description of flow measurement method, if applicable, and any flow data;
- I. Instrument calibration and cleaning record;
- J. Results of field measurements and observations (time, temperature, pH, specific conductance, turbidity, DO, ORP);
- K. Name(s) of sample collector(s);

- L. Sketch map showing location of sampling station and permanent landmarks and/or GPS coordinates (if GPS coordinates do not already exist for the sampling station); and
- M. Number of photos (if taken).

When the sampling activity is completed, the Surface Water Sampling Record will be checked by the Project Manager or his/her designee, and the original record will be placed in the project file.

## **5.0 QUALITY CONTROL**

### **5.1 Equipment Decontamination/Cleaning**

Sample bottles and bottle caps will be cleaned and prepared by the analytical laboratory or their supplier using standard EPA-approved protocols. Sample bottles and bottle caps will be protected from dust or other contamination between time of receipt by the sampling personnel and time of actual usage at the sampling site.

Sampling equipment that will be used at multiple sampling locations will be cleaned after sampling at each location is completed in accordance with the SOP No. 7 (EQUIPMENT DECONTAMINATION).

Equipment such as submersible electric pumps, which cannot be disassembled for cleaning, will be cleaned by circulating a laboratory-grade detergent (e.g., Alconox) and potable water solution through the assembly, followed by clean potable water from a municipal supply, and then by distilled or deionized water. Equipment cleaning methods will be recorded in the field notebook and/or on the Surface Water Sampling Record.

### **5.2 Records Review**

The Project Manager or designated reviewer will check and verify that documentation has been completed and filed per this procedure.

## 6.0 REFERENCES

- U.S Environmental Protection Agency (USEPA), 2003. USEPA Region 8 Technical Standard Operating Procedure, Surface Water Sampling (SOP #EH-01, East Helen Site, Montana). September 2003. Adapted from ERT/REAC SOP 2013 Rev 1.0. Available online at [http://nctc.fws.gov/resources/course-resources/pesticides/Monitoring/Surface%20Water%20Sampling\\_EPA.pdf](http://nctc.fws.gov/resources/course-resources/pesticides/Monitoring/Surface%20Water%20Sampling_EPA.pdf)
- U.S. Geological Survey (USGS), variously dated. National Field Manual for the Collection of Water-Quality Data: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Handbooks for Water-Resources Investigations, Chapters A1-A9. Available online at <http://pubs.water.usgs.gov/twri9A>.

**SURFACE WATER SAMPLING RECORD**

LOCATION ID:

Date: \_\_\_\_\_ Time: \_\_\_\_\_ Weather: \_\_\_\_\_ Page \_\_\_\_ of \_\_\_\_\_

Weather Past 48 hours: \_\_\_\_\_ Personnel: \_\_\_\_\_

Location Description: \_\_\_\_\_

Water Body Type: \_\_\_\_\_ Water Present (Y/N) \_\_\_\_\_ Depth \_\_\_\_\_ Flow Meas (Y/N) \_\_\_\_\_ Reason if N \_\_\_\_\_

**QUALITY ASSURANCE**

Sampling Equipment:

Decontamination: Alconox, Distilled Water, Rinse

Method of Sampling:

**FIELD PARAMETER INSTRUMENTS****pH Meter:** Model: YSI-556 Calibration: 4.00/7.00 pH Buffers

After Calibration Meter Read: \_\_\_\_\_

**Conductivity Meter:** Model: YSI-556 Calibration: 1,413  $\mu\text{S}/\text{cm}$  Conductivity Standard

After Calibration Meter Read: \_\_\_\_\_

**Temperature Meter:** Model: YSI-556**ORP Meter:** Model: YSI-556 Calibration: YSI Zobell Solution**Turbidity Kit:** Model: HF Scientific MicroTPW Turbidity Meter; Calibration: \_\_\_\_\_**SAMPLING MEASUREMENTS**

Sample Collection Time	Depth (ft)	pH	Specific Conductance ( $\mu\text{mhos}/\text{cm}$ )	Temp. ( $^{\circ}\text{C}$ )	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)

**SAMPLE INVENTORY**

Sample Type (circle one): Primary Sample Duplicate Equipment Rinsate Blank

SAMPLE ID: \_\_\_\_\_

Sample Processing		Container Type	Volume (mL)	Number of Bottles	Filtered	Preservative	Comments
Date	Time						

MAP / COMMENTS

UTM Coordinates (NAD83):

SIGNATURE: \_\_\_\_\_

## **STANDARD OPERATING PROCEDURE No. 6**

### **SURFACE WATER DISCHARGE MEASUREMENT**

#### **1.0 SCOPE AND APPLICABILITY**

This Standard Operating Procedure (SOP) describes the protocol for collecting discharge measurements in streams, ditches, springs, seeps, etc. The procedures presented herein are intended to be general in nature and are applicable when referenced by site-specific or project-specific planning documents. Appropriate revisions may be made to accommodate site-specific conditions or project-specific protocols when approved in writing or via email by the Project Manager.

The objective of this SOP is to provide a consistent method for describing a current, and three methods for measuring discharge: (1) volumetric method, (2) area-velocity method, and (3) flume method. Discharge is defined as the volume rate of water flow, including any substances suspended or dissolved in the water. Discharge will be expressed in cubic feet per second (cfs) or gallons per minute (gpm). Note that the protocol for collection of surface water samples is included in SOP No. 5 (WATER QUALITY SAMPLING).

#### **2.0 BASIS FOR METHODOLOGY**

The methods and procedures described in this SOP were developed from these sources:

- Rantz, S.E. et al. (1982) Measurement and Computation of Streamflow: Volume 1, Measurement of Stage and Discharge, U.S. Geological Survey Water Supply Paper 2175. U.S. Government Printing Office, Washington, D.C.
- U.S. Department of the Interior Geological Survey (USGS) (1977) National Handbook of Recommended Methods for Water-Data Acquisition. Office of Water Data Coordination, U.S. Geological Survey, Reston, VA.
- U.S. Environmental Protection Agency (USEPA) (1986) Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual. Environmental Services Division, Region IV, Athens, GA.

### **3.0 PROCEDURES**

The selection of an appropriate method for discharge measurement depends on the flow conditions. In some conditions, the flow measurement methods described here may be impossible to implement (e.g., extreme high-flow conditions). If flow conditions cannot be measured at a specific location, then field personnel will attempt to measure flow at a point upstream or downstream of the sample site. The field personnel will also note the conditions that inhibited more accurate measurement at the designated measurement location.

#### **3.1 Current Description**

In cases where a discharge measurement is not required but a description of the direction and relative rate of flow is useful, the following method for current measurement may be used.

The current within a moving body of water and its direction is variable by location and depth. Current measurement may be used to define the movement of water at a specified location and depth where a sample is collected. Qualitative measurement of current is made by using a strip of soft tape or cloth attached to the end of a pole. The strip will indicate the presence of water flow and direction of flow at the location and depth. The diameter of the pole should be sufficiently small to prevent directional error. Quantitative measurements may be made using a current meter, which determines the water velocity (feet per second) from pressure exerted by the water, or one of the other methods described in Section 3.4.

#### **3.2 Discharge Measurement**

The selection of discharge measurement method depends on stream flow rate and/or specific channel characteristics. For pipes, drain system outfalls, and cases where flows are too small or stream gradients are too high, the volumetric method is appropriate. In cases where water depth is greater than 0.3 feet or the channel cross section is wide, discharge should be measured using the area-velocity method. Where flows are below the practical limit that can be measured with the area-velocity method, the flume method is best.

Where the total discharge is conveyed through two channels or differing types, a combination of these methods may be appropriate.

### **3.3 Volumetric Method**

The volumetric method is a simple and accurate method for measuring flow from small discharges such as gravity flow discharged from pipe outlets. This method involves observing the time required to fill or partly fill a calibrated container to a known volume. Alternatively, in the case of measuring discharge remotely in a sump or standpipe setting, the volumetric method may be performed by capturing flow in a container for a set period of time, no less than 10 seconds, if possible. This volume of water is then measured and discharge is determined.

#### **3.3.1 Equipment**

The volumetric method is particularly useful for the measurement of small flows. Equipment required to make this measurement includes a calibrated container and a stopwatch. Calibrated containers of varying sizes include: 5-gallon bucket, 2-liter graduated cylinder, 1-liter graduated cylinder, 1-liter bucket, etc. Extension rods will be used to hold a container for capturing flow in enclosed areas containing discharging pipes.

#### **3.3.2 Maintenance and Calibration Procedures**

Graduated cylinders are incremented in terms of milliliters and can be easily converted to gallons. The incremental volume of a 5-gallon bucket can be determined by adding known volumes of water and recording the depth after each addition.

#### **3.3.3 Field Procedures**

Upon arrival at the site, the field personnel will evaluate the flow conditions to select the appropriate method for flow measurement. If the flow conditions meet those outlined in Section 3.3, then field personnel will observe and use judgment in approximating the flow volume and will select an appropriately sized volumetric container to use the volumetric method of flow measurement.

Field personnel will use a stopwatch to measure the time required to fill a volumetric container. Field personnel will time flow into the container for a minimum of 10 seconds, if possible. A minimum of five consecutive measurements will be made and noted, and the results will be averaged to determine the discharge.

If remote measurement is necessary, a container will be attached to an extension rod. The field personnel will time flow for a minimum of 10 seconds, if possible. The volume of water will then be poured into a calibrated container, measured, and recorded. A minimum of five such measurements will be made, noted, and the results averaged to determine the discharge.

### 3.3.4 Discharge Calculations

Discharge will be determined initially in gallons per second (gal/s) or in milliliters per second (ml/s). These values will be noted, but the averaged value will be reported in cubic feet per second (cfs). Calculations will be performed as follows:

- Record each of the measurements in terms of gallons per second or milliliters per second, depending on the volumetric container.
- If one of the measurements is different from the other measurements by 50 percent or more, then this value will not be used. Instead, five additional measurements will be taken and, provided that none of these measurements differs by greater than 50 percent from the other measurements, these values will be used.
- Calculate the average of the measured values.
- Leakage around the discharge pipe, if any, will also be estimated and noted.
- Convert the averaged value to cfs as follows:
  - to convert ml/s to cfs, multiply by  $3.53 \times 10^{-5}$
  - to convert gal/s to cfs, multiply by 0.134
- Record discharge in cfs.

### 3.4 Velocity-Area Method

A vertical axis current meter (e.g., March-McBirney Model 2000 Flo-Mate, Hach FH950, Son-Tek, or equivalent) may be used to perform velocity-area method discharge measurements. These instruments use electromagnetic induction to determine the velocity of water. As water flows over a sensor it changes the voltage within the sensor. The changing voltage is processed by the instrument which presents the output as a linear measurement of velocity. Vertical axis current meters can be used at any depth greater than 0.15 feet.

#### 3.4.1 Introduction

The current meter measures velocity in flowing water at a point. The velocity-area method requires measurement of the mean velocity in selected subsections of the stream cross-section. By dividing the stream width into subsections, discharge becomes the total of discharges measured in each subsection. Velocity ( $V$ ) is measured at each subsection, and discharge becomes the sum of the products of each velocity point and the cross-sectional area of each subsection:

$$Q = \sum(A_i * V_i)$$

where:  $Q$  = Streamflow in cfs,  
 $A$  = Area of stream subsection in square feet, and  
 $V$  = velocity in feet per second.

A cross section is defined by the depths at vertical points (# 1, 2, 3, ...n) where the average velocity is measured.

In general, the person(s) measuring discharge should strive to measure no more than 5 percent of the flow in any one subsection (for small streams this is often not practical). The person(s) measuring discharge should divide the channel cross-section into subsections. The total number of subsections (segments) should be large enough to ensure no more than 10 percent of the total flow is contained in any one segment (preferably 5 percent). The location of the metering sites need not be equally spaced across the stream. The

locations should be more closely spaced where water depth or velocity are changing most rapidly or where the channel and flow are more irregular.

Velocities will be measured by the current meter at each measuring point, and each velocity reading will be recorded when the meter stabilizes.

### 3.4.2 Required Measurement Conditions

To make an area-velocity discharge measurement, the following conditions are required:

1. The stream must be channelized or contain relatively straight sections upstream of and at the measurement location.
2. Depth must be greater than 0.2 foot across most of the crosssection being measured.

The ideal channel cross-section is trapezoidal in shape, completely smooth in boundary materials, and possesses a uniform velocity distribution. Such an ideal condition is rarely observed. Therefore, minor modifications to the stream channels will be used to optimize measurement conditions. These modifications may include removal of aquatic vegetation, ice, and moving small stones that impact velocity upstream or downstream of the cross-section. However, no modifications should be made while measurements are being taken.

If flow conditions permit, current meter measurements will be made by wading. Do not switch from one meter to another in the middle of a discharge measurement. The person(s) measuring discharge should stand downstream at arm's length to the side of the flow sensor.

Under open channel laminar flow conditions, the effect of fluid contact with the bed of a stream channel and the air is a vertical distribution of velocities. Consistent with this velocity distribution, actual observation and mathematical theory has demonstrated that a single measurement of velocity taken at 0.6-depth or the average of two point velocities taken at 0.2 and 0.8 of the depth below the surface accurately results in mean velocity in the vertical (USGS Water-Supply Paper 2175, pages 133-134).

If the stream is generally less than 2.5 feet deep, the six-tenths (0.6) method will be used. If the stream is generally greater than 2.5 feet, the two- and eight-tenths (0.2 and 0.8) method, also known as the two-point method, will be used. A complete discussion concerning how to set the wading rod to place the current meter at proper depths is contained in Section 3.4.5, Field Procedures.

In the 0.6-depth method, an observation of velocity made in the vertical at 0.6 of the depth below the surface is used as the mean velocity in the vertical. In the two-point method of measuring velocities, observations are made in each vertical at 0.2 and 0.8 of the depth below the surface. The average of the two observations is taken as the mean velocity in the vertical.

A depth of 1.25 feet will accommodate the 0.6-depth method without causing the meter to be set closer than 0.5 feet from the stream bed; if the meter is set any closer to the stream bed, it will under-register the velocity.

### 3.4.3 Equipment

Current meters and depth and width measuring devices are needed for measurement of discharge. The equipment includes:

- Top-setting wading rod and current meter
- Width-measuring devices, either engineer's tape or tagline
- Stakes for width-measuring devices
- Calculator

*Top-Setting Wading Rod.* The depth-measuring device that will be used is the wading rod. The current meter is attached to the wading rod. The top-setting wading rod has a 2-inch hexagonal main rod for measuring depth and a 3/8-inch diameter round rod for setting the position of the current meter.

*Current Meter.* Vertical axis current meter, for example, Marsh-McBirney Model 2000 Flow-Mate, Hach FH950, or Son-Tek.

*Engineer's Tape or Tagline.* Tape measures or premarked taglines are used for stream width measurements. Orientation normal to the flow patterns of the stream and elimination of most of the sag, through support or tension, are recommended for improved accuracy.

#### 3.4.4 Maintenance and Calibration Procedures

The Marsh-McBirney Model 2000 Flo-Mate and Hach FH950 will have a zero check performed on the sensor to ensure accurate readings are obtained. First clean the sensor. Then place the sensor in a five gallon bucket of water. Keep it at least three inches away from the sides and bottom of the bucket. To make sure the water is not moving, wait 10 to 15 minutes after positioning the sensor and before taking any zero readings. If needed, follow the manufacturer recommendations to zero adjust the sensor.

To ensure reliable observations of velocity, it is necessary that the current meter be kept in good condition. Before and after each discharge measurement, the meter will be examined for damage, wear, or faulty alignment. During measurements, the meter will be observed periodically when it is out of the water to be sure that the sensor is free of debris.

Meters will be cleaned daily when in use. If measurements are made in sediment-laden water, the meter will be cleaned immediately after each measurement.

#### 3.4.5 Field Procedures

Upon arrival at the site, field personnel will evaluate the flow conditions to determine which measurement method is appropriate. Based on flow conditions, the appropriate flow meter (e.g., Marsh-McBirney Model 2000 Flo-Mate meter, Hach FH950, or Son-Tek) will be selected to perform an area-velocity measurement.

At each measurement point (or section) across the stream crosssection, depth is measured prior to measurement of velocity. Place the wading rod about 5 feet downstream from the tagline. Place the wading rod in the stream so the base plate rests on the streambed. The depth of water is read from the graduated main rod. The main rod is graduated into 0.1-foot

increments. These increments are indicated by a single score in the metal. Half-foot increments are marked by two scores in the metal, and each foot is marked by three scores in the metal. A vernier scale on the upper handle of the rod corresponds to 0.1-foot increments, and has 1 through 9 in raised numbers next to raised marks. A sliding, adjustable rod, known as the setting rod, to which the meter is attached, has single scored marks that are aligned with values on the vernier scale.

In high-velocity areas, it is recommended that depth be read as the value between depth on the upstream side of the rod and depth on the downstream side of the rod. Depth is measured to the nearest 0.02 foot. This depth is used to set the vertical location of the current meter.

The setting rod is then adjusted downward so that the scored mark of the setting rod that corresponds to the range of depth in feet (e.g., if depth = 0.4, range in feet = 0; or if depth = 1.72, range in feet = 1) is aligned with the stream depth value transposed to the vernier scale. This automatically positions the meter for use in the 0.6 method as the meter is then six-tenths of the total depth from the surface of the water.

For using the two-point method of velocity measurement, the depth of water is divided by 2. This value is set so that the meter will be at the 0.8-depth position from the water surface. The depth of water is then multiplied by two, and this value is set. The meter will then be at the 0.2-depth position measured down from the water surface. These two positions represent the conventional 0.2- and 0.8-depth positions. If depths are less than 0.3 foot, the 0.5 method may be used. The observation depth recorded will then be 0.5 of the total depth.

If water quality or sediments are sampled in conjunction with discharge measurement, samples will be collected prior to making discharge measurements.

The following steps are to be followed in discharge measurement:

- Evaluate the measurement location. Choose a location where flow is least turbulent. If the prescribed location is in a stream reach with highly turbulent flow conditions, try to select a location immediately upstream or downstream. Flow should be visible from bank to bank. Eddies and slack water must not be present.
- Remove aquatic vegetation, ice, or other minor flow impediment s. When such modifications are made, exercise great care to avoid unnecessary movement of sediments and allow flow to stabilize before the current metermeasurement begins.
- Position a tape about 1 foot above the surface of the waterSecure the tape so that it remains taut and perpendicular to the channel.
- Select a starting point at either the left bank (left edge of water, LEW) or the right bank (right edge of water, REW). LEW and REW are determined wh en facing downstream.
- Note the distance in feet, and the stream direction, that thiscross-section lies from the prescribed location. For example, the note may read "25 feet downstream" or "15 feet upstream."
- Measure the width of the stream. Select the number of subsections in which to measure velocity attempting to measure no more than 10 percent of the total flow in any one section, if possible.
- After determining the distance desired between measuring point s, commonly referred to as sections, measurement can begin. Record the ban k at which measurements start on the discharge measurement notes as "REW" using REW or LEW depending upon whether starting at the right or the left edge of the water.
- Note the distance to the beginning edge of water from the initial point. The initial point is an arbitrary point on the tape, preferably zero, whichies on the shoreside of the stream. All station locations are recorded as distances from the initial point.
- Proceed to the first station beyond the edge of water. Recordthe distance from the initial point on the discharge measurement notes. Place the wa ding rod into the stream so the base plate rests on the stream bed.
- Stand downstream of the tagline or tape and face upstream. Do not stand behind or close to the meter. Raise the current meter on the wading rod so that it is well above the surface of the water.

- Measure stream depth at the measurement point as indicated on the wading rod. Record the stream depth to the nearest 0.02 foot (for example 0 .32 feet or 1.54 feet).
- Lower the meter to the required depth and record the observation depth. The observation depth as a fraction of total depth is 0.6, 0.2, 0.8 or occasionally 0.5.
- Field personnel will stand in a position that least affects the velocity of the water passing the current meter. That position is usually obtained by facing upstream with the arm fully extended. The person(s) will stand at about a 45 -degree angle downstream from the wading rod. The wading rod is held in a vertical position with the meter parallel to the direction of flow. Avoid standing in the water when possible.
- Field personnel will wait for the velocity on the meter's screen to stabilize and record in the appropriate column. The flow meter must be aligned parallel to the direction of flow.
- Proceed to the next station. Record the distance from the initial point to the station. Repeat measurements of depth and velocity. Continue in this manner across the stream.
- After recording the distance measurement at the last station record the ending edge of water that is reached (e.g., LEW [or REW]).
- Note velocity and depth at the edge of water as zero.
- Evaluate and record flow characteristics, weather conditions, air temperature, water temperature, observer(s), type of meter, and remarks.
- If an insufficient number of subsections have been used for the measurement, repeat the measurement steps. Begin from the opposite bank from where the previous measurement began.

### 3.4.6 Discharge Calculations

- Calculate discharge on the discharge notes as follows: Use the distances from initial point to compute width for each subsection. The first width is computed by subtracting the first distance (edge of water) from the second distance and dividing this quantity by two. The second width will be the difference between the third distance and the first distance divided by two. For each subsequent width, subtract the previous station distance from the following station distance and divide this quantity by two. The final width is calculated as the difference between the final distance and the second-to-last distance divided by two. Sum the width column and check to ensure that the calculated width equals the distance between the REW and LEW.

- Multiply the width by the depth for each station to determine the area of each subsection. Sum the areas to determine total area.
- Multiply the velocity by the area for each station to obtain the discharge for each subsection.
- Sum the discharges for each subsection to determine total discharge and record the value.
- If two sets of discharge measurements beginning at opposite banks were taken, repeat the discharge calculations for the second set of data. Average the total discharges for the two measurements. Record the average value and report it for input into the database.

### 3.5 Control Structures

Control structures, such as flumes, can be used to determine discharge. These structures have regular dimensions that allow for a consistent relationship between water level and discharge. This section describes use of Parshall flumes to measure discharge.

#### 3.5.1 Introduction

A calibrated constriction placed in a stream channel changes the level of the water in or near the constriction. Flumes are constructed so that a restriction in the channel causes the water to accelerate, producing a corresponding change (drop) in the water level. When the physical dimensions of the flume constriction are known, discharge through constriction may be determined from measurement of depth. See below for a description of discharge measurement for Parshall flumes.

Typical flumes consist of three sections:

- A converging section to accelerate the approaching flow;
- A throat section, whose width is used to designate flume size; and
- A diverging section, designed to ensure that the level downstream is lower than the level in the converging section.

The stage of a stream is the height of the water surface above an established elevation. Stage is usually expressed in feet. The Parshall flume consists of a converging section with

a level floor, a throat section with a downward sloping floor and a diverging section with an upward sloping floor. The principal feature of the Parshall flume (developed by R. Parshall in 1922) is an approach reach having converging sidewalls and a level floor, the downstream end of which is a critical depth cross-section. The primary stage measurement is made in the approach reach at some standard distance upstream from the critical-depth cross-section.

The flumes are designated by the width (w) of the throat. Flumes having throat widths from 3 inches (in.) to 8 feet (ft.) have a rounded entrance whose floor slope is 25 percent. Smaller and larger flumes do not have that feature.

### 3.5.2 Required Measurement Conditions

Ideally, flow rate through a flume may be determined by measurements at a single point some distance downstream from the inlet and above the throat.

### 3.5.3 Equipment

The following equipment will be needed:

- Current meter
- Carpenter's level
- Framing square
- Measuring tapes
- Staff gauge

### 3.5.4 Maintenance and Calibration Procedures

All flumes will be inspected to determine that entrance conditions provide a uniform influent flow distribution, the converging throat section is level, and that the throat section walls are vertical. The flume will be closely examined to determine that it is discharging freely. Any problems observed during the inspection will be noted and reported to the field manager.

### 3.5.5 Procedures

Steps to be followed in measuring discharge.

- Remove any material that may have accumulated in the flume or on the weir;
- If the station includes a chart recorder, inspect the strip chart on the recorder to verify that it is operating;
- Note any deterioration of the station; report these conditions to the field manager at the conclusion of daily data collection activities;
- Measure and record the throat width (W) to the nearest 1/10 of an inch;
- Use the staff gauge to measure the gauge height (H) to the nearest 0.02 foot;
- Calculate discharge as described in Section 3.5.6; and
- Record the calculated discharge and the time and date of the site visit.

### 3.5.6 Discharge Calculations

A set of flume tables is necessary for calculating flows. The flume tables are specific to the type and size of flume and are usually supplied by the flume manufacturer. Based on the gauge height (head, H, in feet) and the throat width of the flume (size of flume, W), the discharge is read directly from the table provided from the manufacturer. Note that the approximate values of discharge for heads other than those shown may be found by direct interpolation in the table. The following equation and table gives calculation coefficients for discharge calculations with Parshall flumes.

The free-flow discharge equations for the standard Parshall flume sizes are of the form:

$$Q = Ch_a^n$$

where:

$h_a$  = measuring head (ft)  
 $Q$  = discharge ( $\text{ft}^3/\text{s}$ )  
 $C$  and  $n$  = coefficients specific to flume size

Coefficients ( $C$ ) and exponents ( $n$ ) for Parshall flume discharge calculations are listed in the following table.

Throat width	Coefficient ( $C$ )	Exponent ( $n$ )
1 in	0.338	1.55
2 in	0.676	1.55
3 in	0.992	1.55
6 in	2.06	1.58
9 in	3.07	1.53
1 ft	3.95	1.55
2 ft	8.00	1.55
3 ft	12.00	1.57
4 ft	16.00	1.58
5 ft	20.00	1.59
6 ft	24.00	1.59
7 ft	28.00	1.60
8 ft	32.00	1.61
10 ft	39.38	1.60
12 ft	46.75	1.60
15 ft	57.81	1.60
20 ft	76.25	1.60
25 ft	94.69	1.60
30 ft	113.13	1.60
40 ft	150.00	1.60
50 ft	186.88	1.60

### 3.6 Documentation

Information required by this SOP will be documented in detail in a field notebook and/or on a Surface Water Flow Record form (attached form or similar available in paper or electronic format). This information includes the calibration data for flow measurement devices and field discharge measurement data.

Documentation will also include the type of flow measurement device, including a model number; a detailed description of measurement location and weather conditions during the measurement; and calculations.

## **4.0 QUALITY ASSURANCE/QUALITY CONTROL**

### **4.1 Calculation Check**

All calculations will be reviewed for accuracy and conformance with these procedures. The calculation review will be performed by a technically qualified individual before results are reported or interpreted. The calculation check shall be documented by recording the reviewer's initials and date of review on the calculation sheet . A copy of the reviewed calculations should be included in the project file.

### **4.2 Records Review and Management**

The Project Manager or designated reviewer will verify that documentation has been completed and filed per this procedure.

## **5.0 REFERENCES**

Rantz, S.E. et al., 1982. Measurement and Computation of Streamflow: Volume 1, Measurement of Stage and Discharge, U.S. Geological Survey Water Supply Paper 2175. U.S. Government Printing Office, Washington, D.C.

U.S. Department of the Interior Geological Survey (USGS), 1977. National Handbook of Recommended Methods for Water-Data Acquisition. Office of Water Data Coordination, U.S. Geological Survey, Reston, VA.

U.S. Environmental Protection Agency (USEPA), 1986. Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual. Environmental Services Division, Region IV, Athens, GA.

## **STANDARD OPERATING PROCEDURE No. 7**

### **EQUIPMENT DECONTAMINATION**

#### **1.0 SCOPE AND APPLICABILITY**

This Standard Operating Procedure (SOP) describes the methods to be used for decontamination of all reusable field equipment that could become contaminated during use and/or sampling. Field equipment may include split spoons, reusable bailers, trowels, scissors, shovels, hand augers, or any other type of equipment used during field activities. Decontamination is performed as a quality assurance measure and a safety precaution; it prevents cross contamination between samples and also helps to maintain a clean working environment. The procedures presented herein are intended to be general in nature and are applicable when referenced by site-specific or project-specific planning documents. Appropriate revisions may be made to accommodate site-specific conditions or project-specific protocols when approved in writing or via email by the Project Manager.

Decontamination is achieved primarily by rinsing with liquids which may include: soap and/or detergent solutions, potable water, distilled weak acid solution, and/or methanol or other solvent. Equipment may be allowed to air dry after being cleaned or may be wiped dry with chemical-free towels or paper towels if immediate re-use is necessary.

At most project sites, decontamination of equipment that is reused between sampling locations will be accomplished between each sample collection point. Waste produced by decontamination procedures, including waste liquids, solids, rags, gloves, etc., should be collected and disposed of properly, based upon the nature of contamination. Specific details for the handling of decontamination wastes are addressed in SOP No. 3 (STORAGE AND DISPOSAL OF SOIL, DRILLING FLUIDS, AND WATER GENERATED DURING FIELD WORK) or may be specified by a project plan.

## 2.0 BASIS FOR METHODOLOGY

The methods and procedures described in this SOP were developed from these sources:

- ASTM D5088. Standard Practice for Decontamination of Field Equipment Used at Waste Sites. American Society for Testing and Materials (ASTM) International, West Conshohocken, PA, 2008.
- Parker and Ranney, 1997a. Decontaminating Ground Water Sampling Devices, CRREL Special Report 97-25, U.S. Army Engineer Cold Regions Research and Engineering Laboratory, Hanover, NH.
- Parker and Ranney, 1997b. Decontaminating Materials Used in Ground Water Sampling Devices, CRREL Special Report 97-24, U.S. Army Engineer Cold Regions Research and Engineering Laboratory, Hanover, NH.

## 3.0 PROCEDURES

### 3.1 Responsibilities

It is the responsibility of the field sampling supervisor to ensure that proper decontamination procedures are followed and that all waste materials produced by decontamination are properly managed. It is the responsibility of the project safety officer to draft and enforce safety measures that provide the best protection for all persons involved directly with sampling and/or decontamination.

It is the responsibility of any subcontractors (e.g., drilling contractors) to follow the proper, designated decontamination procedures that are stated in their contracts and outlined in the Site-Specific Health and Safety Plan. It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and ensure that any contaminants are not negligently introduced to the environment.

### 3.2 Supporting Materials

Materials needed for equipment decontamination include:

- Cleaning liquids: laboratory grade soap and/or detergent solutions (Alconox, etc.), potable water, distilled water, methanol, weak nitric acid solution, etc.
- Personal protective safety gear as defined in the Site-Specific Health and Safety Plan
- Chemical-free towels or paper towels
- Disposable nitrile gloves
- Waste storage containers: drums, boxes, plastic bags, etc.
- Cleaning containers: plastic and/or stainless steel pans and buckets
- Cleaning brushes
- Aluminum foil

### 3.3 Methods

The extent of known contamination will determine the degree of decontamination required. If the extent of contamination cannot be readily determined, cleaning should be done according to the assumption that the equipment is highly contaminated. Decontamination procedures should account for the types of contaminants known or suspected to be present. In general, high levels of organic contaminants should include an organic solvent wash step, and high levels of metals contamination should include a weak acid rinse step.

The procedures listed below constitute the full field decontamination procedure. If different or more elaborate procedures are required for a specific project, they may be specified in the project planning documents. Such variations in decontamination protocols may include all, part, or an expanded scope of the decontamination procedure stated herein.

1. Remove gross contamination from the equipment by dry brushing, and rinse with potable water.
2. Wash with laboratory-grade detergent solution.

3. Rinse with potable water.
4. Rinse with methanol (optional, for equipment potentially contaminated by organic compounds).
5. Rinse with acid solution (optional, for equipment potentially contaminated by metals).
6. Rinse with distilled or deionized water.
7. Repeat entire procedure or any parts of the procedure as necessary.
8. Air dry.

#### **4.0 DOCUMENTATION**

Field notes will be kept describing the decontamination procedures followed. The field notes will be recorded according to procedures described in JRS SOP No. 1 (FIELD DOCUMENTATION).

#### **5.0 QUALITY CONTROL**

To assess the adequacy of decontamination procedures, field rinsate blanks may be required. The specific number of field rinsate blanks will be defined in the project-specific Sampling and Analysis Plan (SAP) or Quality Assurance Project Plan (QAPP).

Rinsate blanks with elevated or detected contaminants will be evaluated by the Project Manager, who will relay the results to the field personnel. Such results may be indicative of inadequate decontamination procedures that require corrective actions (e.g., retraining).

#### **6.0 REFERENCES**

ASTM D5088-02 (2008). Standard Practice for Decontamination of Field Equipment Used at Waste Sites. American Society for Testing and Materials (ASTM) International, West Conshohocken, PA, 2008. Available online at <http://www.astm.org/>

Parker and Ranney, 1997a. Decontaminating Ground Water Sampling Devices, CRREL Special Report 97-25, U.S. Army Engineer Cold Regions Research and Engineering Laboratory, Hanover, NH.

Parker and Ranney, 1997b. Decontaminating Materials Used in Ground Water Sampling Devices, CRREL Special Report 97-24, U.S. Army Engineer Cold Regions Research and Engineering Laboratory, Hanover, NH.

## **STANDARD OPERATING PROCEDURE No. 20**

### **INORGANIC DATA EVALUATION**

#### **1.0 SCOPE AND APPLICABILITY**

This Standard Operating Procedure (SOP) describes the procedures for the evaluation of data generated through inorganic laboratory analysis of samples. These procedures apply to three levels of data evaluation: data completeness check, data review and data validation.

The QAPP, Sampling and Analysis Plan (SAP) and/or any other relevant site-specific or project-specific documents must be reviewed before this SOP is used to evaluate data. The individual performing the data evaluation shall be familiar with the analytical methods and other procedures used for the project. Familiarity with project and laboratory quality control requirements is critical to appropriate use of this procedure. A general description of the different levels of data evaluation is provided below and discussed in detail in Section 4.0 of this SOP.

##### **1.1 Data Completeness Check**

Data completeness checks may be performed on both Level 2 standard data reports and Level 4 USEPA Contract Laboratory Program (CLP)-like laboratory reports as specified in the project planning documents and/or by the project team or regulatory agencies. These completeness checks may be performed as part of a data review or validation or may be performed as a stand-alone evaluation. Completeness checks only document the presence or absence of applicable QC data in the laboratory data package, and no qualification of sample results is necessary based on this data evaluation.

##### **1.2 Data Review**

Data review includes a review of laboratory quality assurance (QA) and quality control (QC) sample results provided in Level 2, or equivalent, standard laboratory reports. Data review can also be performed on CLP-like Level 4 data packages if required. In addition to sample results, Level 2 laboratory reports provide QA/QC summaries that

typically include results for method blanks, laboratory control samples (LCS), matrix spike (MS) samples, and duplicates, as well as the review of field QC samples (e.g., field blanks and field duplicates). Data review is differentiated from data validation because the review consists of an assessment of the laboratory QA/QC summary reports only.

### 1.3 Data Validation

Data validation includes the evaluation of the QA/QC results described above as well as an evaluation of additional validation of calculations, calibrations, internal standards, tunes, etc. provided in Level 4 CLP-like data reports. A minimum of 10% of the data reports produced annually by each laboratory analyzing environmental monitoring samples will be reported as CLP-like data reports and validated according to the data validation procedures described in this SOP (Section 4.3). Data validation of the CLP-like data reports will be performed using the general protocols and processes described in this SOP, as applicable to the method calibration and QC limits specified on Tables 2-2 through 2-6 of the QAPP, the Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review (NFG; USEPA, 2010) and to the extent possible when certain non-CLP methods are used, laboratory SOPs.

The following table summarizes the common elements and differences between a data completeness check, data review and data validation.

**Scope of Data Reviews**

Item	Data Completeness Check	Data Review	Data Validation
Review of Work Plan, SAP and/or QAPP	Presence only	X	X
Review of Chain-of-Custody Records	Presence only	X	X
Review of Case Narrative	Presence only	X	X
Verify that preservation and holding time requirements met.	Presence only	X	X
Verify that the required frequency of field QC samples was met.	Presence only	X	X
Verify that ICP/MS tune analyses were performed at the required frequency and that results are within control limits.			X

Verify that all instrument calibration were performed at the required frequency and concentrations and that results are within control limits.			X
Verify that laboratory blanks were performed at the required frequency and that results are within the control limits.	Presence only	X	X
Verify that field blank results are within the control limits.	Presence only	X	X
Verify that all Laboratory Control Sample (LCS) were performed at the required frequency and that results are within control limits.	Presence only	X	X
Verify that matrix spike (MS) sample were performed at the required frequency and that results are within control limits.	Presence only	X	X
Verify that analytical duplicates were performed at the required frequency and that RPDs are within control limits.	Presence only	X	X
Verify that ICP Serial Dilutions were performed at the required frequency and that results are within control limits.			X
Verify that ICP/MS internal standards were included with each sample and that results are within control limits.			X
Verify that field duplicate measurements are within the control limits.	Presence only	X	X
Verify sample calculations.			X
Verify that project completeness goals were met.		X	X

## 2.0 BASIS FOR METHODOLOGY

The data evaluation procedures described in this SOP are based on the guidance specified in the QAPP and the protocols specified in the USEPA Contract Laboratory Program (CLP) National Functional Guidelines (NFGs) for Inorganic Superfund Data Review (USEPA, 2010). The data evaluation procedure described in this SOP may be used for the evaluation of standard laboratory data reports (Level 2 reports) or CLP-like/Level 4 laboratory data reports. CLP-like/Level 4 data reports are needed in order to complete the validation procedure described in this SOP. It is not meant to replace or incorporate all of the procedures and protocols necessary to complete data validation

per the USEPA NFGs. Data qualification may or may not be performed for data review, however data validation will include data qualification.

### 3.0 DEFINITIONS

Definitions of accuracy, precision, and completeness and methods for computing their measures are provided below. Descriptions of the contents of Level 2 Standard data packages and Level 4 CLP-like data packages are provided in Section 4.2 of this SOP.

#### a. Accuracy

Accuracy is the degree of difference between the measured or calculated value and the true value. Data accuracy and analytical bias are often evaluated by the analysis of LCS and MS samples, with results expressed as a percentage recovery measured relative to the true (known) concentration.

The percentage recovery for LCS samples is given by:

$$\text{Recovery (\%)} = \frac{A}{T} \times 100$$

where: A = measured concentration of the surrogate or LCS; and  
T = known concentration.

The percentage recovery for MS samples is given by:

$$\text{Recovery (\%)} = \frac{A - B}{T} \times 100$$

where: A = measured concentration of the spiked sample;  
B = concentration of unspiked sample; and  
T = amount of spike added.

Laboratory blanks, and often, field blanks are analyzed to quantify artifacts introduced during sampling, transport, or analysis that may affect the accuracy of the data.

**b. Precision**

Precision is the level of agreement between duplicate measurements of the same characteristic. Laboratory precision, or analytical error, is assessed by determining the agreement of results for replicate measurements of the same sample. Field precision is assessed by determining the agreement for results for two independent samples collected from the same site at the same time. Precision may be evaluated using LCS/LCSD samples, MS/MSD samples, analytical duplicate samples and/or field duplicate samples. The comparison is made by calculating the relative percent difference (RPD) as given by:

$$\text{RPD (\%)} = \left| \frac{2(S_1 - S_2)}{S_1 + S_2} \right| \times 100$$

where: S<sub>1</sub> = measured sample concentration; and  
S<sub>2</sub> = measured duplicate concentration.

**c. Completeness**

Completeness is the percentage of usable data measurements obtained, as a proportion of the number of data measurements planned for the project. Completeness is affected by such factors as sample bottle breakage and acceptance/non-acceptance of analytical results. Percentage completeness (C) is given by:

$$C (\%) = \frac{V}{P} \times 100$$

where: V = number of usable data measurements obtained; and  
P = number of data measurements planned.

**d. Data Qualifier Flags**

As a result of the data review or validation procedures (but no data completeness checks), data qualifier flags may be applied to individual analytical results if qualification for project data usability is appropriate. Definitions of the flags applied for data qualification are as follows:

<u>Flag</u>	<u>Definition</u>
J	The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
J+	The result is an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
UJ	The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

An explanation regarding the assignment of qualifiers in accordance with the review procedures is detailed below in Section 4.2.

**4.0 PROCEDURES**

The data evaluation documentation requirements and procedures for data completeness checks, data review, and data validation are described below in the following sections.

#### **4.1 Data Completeness Check Procedure**

Data completeness checks can be performed as a stand-alone evaluation or as part of a full data review or validation. A data completeness check is performed to verify that the laboratory data provided are complete. The following shall be reviewed for Level 2 Standard data reports and Level 4 CLP-like data reports.

Level 2 Standard data reports shall include the following information for each sample:

- Field and laboratory sample identification;
- Sample result, method detection limit, and reporting limit, with appropriate units;
- Dilution factor
- Sample collection, receipt, and analysis dates;
- Analytical method(s) references; and
- Laboratory qualifiers and definitions.

In addition, Level 2 Standard data reports shall include the following information in a QA/QC summary:

- Method blank results for each analyte;
- LCS results and laboratory control limits for each analyte;
- MS results and laboratory control limits for each analyte, if applicable;
- Analytical duplicate results and laboratory control limits for each target analyte (LCSD and/or MSD results may be provided instead of analytical duplicate results); and
- Confirmation of instrument calibration; and
- Copies of the signed COCs.

Level 4 CLP-like laboratory reports shall include the following information for each sample, at a minimum:

- Field and laboratory sample identification;
- Sample result, method detection limit, and reporting limit, with appropriate units;
- Sample collection and receipt dates;
- Sample preparation and analysis date/time;
- Dilution factor;
- Preparation and analysis batch numbers or identification;

- Sample matrix;
- Analytical method(s) references;
- Percent moisture determination; and
- For solid-matrix samples, identify basis of reporting (i.e., wet-weight or dry-weight basis).

The following additional information will also be provided in Level 4 CLP-like data reports, as applicable for the reported analytical methods:

- Case narrative;
- Copies of the signed COCs;
- Laboratory method/preparation blank;
- Initial calibration verification (ICV), and continuing calibration verification (CCV);
- Initial calibration blanks (ICB), and continuing calibration blank (CCB);
- Interference check sample, if applicable;
- Matrix spike (MS), and when applicable matrix spike duplicate (MSD), sample recovery and, when applicable, MS/MSD relative percent difference (RPD);
- Post-digest spike sample recovery;
- Laboratory duplicate;
- Laboratory control sample (LCS) recovery;
- ICP and ICPMS serial dilution percent differences;
- MDLs;
- ICP inter-element correction factors;
- ICP and ICPMS linear ranges;
- Preparation log;
- Analysis run log;
- Instrument raw data for verification;
- ICPMS tunes;
- ICPMS internal standards relative intensity summary;
- Sample log-in sheet; and
- Deliverables inventory sheet.

## 4.2 Data Review Procedure

The data review procedure for review of a Level 2 Standard data report is as follows. Data may or may not be qualified during data review depending on the project specifications.

- A. Review copies of the Chain-of-Custody records (COCs). Verify that all necessary information was provided on each COC and that all necessary signatures are present. Review laboratory records of sample temperature upon receipt and preservation information, if available, to verify that samples were properly preserved. Professional judgment may be used to determine if data qualification is necessary due to temperature exceedances and/or preservation deviations. Verify that all samples listed on the COCs were analyzed for the appropriate parameters. Note any problems documented on the COCs by either the laboratory or the sampler.
- B. Briefly review and summarize the laboratory case narrative, if present. Note any data that are indicated as outside of control limits.
- C. For each sample and each parameter, verify that the analyses were performed within the recommended holding time. For sample analyses performed outside the recommended holding times, sample results may be qualified as described in the QAPP or USEPA NFGs (2010), though professional judgment and project-specified requirements should be used.
- D. Identify any field QC samples and verify that the field QC samples specified in the Work Plan, QAPP or other relevant project documents have been collected at the correct frequency.
- E. Review the results of all field/equipment blanks and the laboratory method blanks. If an analyte was detected in a blank, the corresponding sample concentrations will be compared to the blank concentrations. Sample results may be qualified as described in the QAPP or USEPA NFGs (2010), though

professional judgment should be used to carefully evaluate the effect of blank concentrations on the sample data.

- F. Check the matrices, units, detection limits and reporting limits to verify that they are reported correctly and meet the project-specific requirements, if provided.
- G. Review all LCS (and LCSD, if available) recoveries and verify that they were within the project-specified control limits. If project-specific control limits are not provided, use the laboratory's control limits. LCS materials may not be available for all matrices. Sample results may be qualified as described in the QAPP or USEPA NFGs (2010), though professional judgment and project-specified requirements should be used.
- H. Review all MS (and MSD, if available) recoveries and verify that they were within the project-specified control limits. If project-specific control limits are not provided, use the laboratory's control limits. If analyzed and reported, post-digestion spike information should also be reviewed. Sample results may be qualified as described in the QAPP or USEPA NFGs (2010), though professional judgment and project-specified requirements should be used. For MS results that do not meet the control limits, the reviewer may choose to apply qualifiers to all samples of the same matrix associated with the MS, if the reviewer considers the samples sufficiently similar.

If an analytical duplicate was analyzed, compare the laboratory calculated RPD and compare this to the project-specified control limits. If a project-specific control limit is not available, use the laboratory's control limits. However, if one or both of the results are less than five times the PQL, use  $\square$  PQL as the control limit for aqueous samples and  $2x \square$  PQL as the control limit for non-aqueous (i.e., soil, sediment, tissue) sample matrices unless project-specific control limits are provided. If the analytical duplicate results fall outside of the control limits, sample results may be qualified as described in the QAPP or USEPA NFGs (2010), though professional judgment and

project-specified requirements should be used, LCS/LCSDs and/or MS/MSDs may be analyzed in place of, or in addition to, an analytical duplicate. The RPDs for LCS/LCSD and MS/MSD pairs shall be evaluated in the same manner as described above for analytical duplicates.

- I. If field duplicates were analyzed, calculate the RPD for each parameter and compare the RPDs to project-specified control limits. If project-specific control limits are not available, use 30 percent for aqueous samples and 50 percent for soil/solid/vegetation tissue samples. However, if one or both of the results are less than five times the PQL, use  $\pm$  PQL as the control limit for aqueous samples and  $2\pm$  PQL as the control limit for non-aqueous (i.e., soil, sediment, tissue) sample matrices unless project-specific control limits are provided. If the field duplicate results fall outside of the control limits, the associated field duplicate results should be qualified in the same manner described above for analytical duplicates as described in the QAPP or USEPA NFGs (2010), though professional judgment and project-specified requirements should be used. Professional judgment will be used to determine whether additional sample results, in addition to the field duplicate sample results, should also be qualified.
- J. Determine whether the project's analytical completeness goal was met. Note any rejected data.

The data reviewer may also provide a brief summary of the accuracy, precision and completeness of the data set. The qualifier flag assigned to the data will be summarized in a table and/or entered into the electronic data deliverable, as specified in the project's QAPP or SAP.

#### 4.3 Data Validation Procedure

A minimum of 10% of the data reports produced annually by each laboratory analyzing environmental monitoring samples from Smoky Canyon Mine will be reported as CLP-like data reports and validated according to the data validation procedures described in this SOP. The data validation procedure shall include all of the above steps in the data

review procedure with additional steps as outlined below. These additional steps include the recalculation of instrument and sample results from the laboratory instrument responses for a subset of the data. These recalculated results are compared to the laboratory reported results to confirm that the instrument outputs were correctly reported. Also, additional QC summary reports will be reviewed including the ICP/MS tune summary, the instrument calibrations, the interference check sample summary, the serial dilution sample summary, and the internal standard relative intensity summary. Data will be qualified during the data validation procedure with the appropriate qualifiers as specified in the QAPP and consistent with USEPA's NFG (2010). A more complete description of the additional steps to be followed in data validation is presented below.

- A. Verify sample calculations for a few of each sample results and identify and document any calculation errors if any are present. The raw instrument output will be reviewed to confirm that the analyte concentrations were reported correctly.
- B. Verify that the ICP/MS tune analysis data requirements were met and results were within QC limits. Review the raw data for a subset of the tune results and confirm that the raw data matches the results summarized on the ICP-MS Tune summary form. If the ICP/MS tune analysis results fall outside of the control limits, the associated sample results should be qualified as described in the QAPP or USEPA NFGs (2010).
- C. Verify that the instrument calibration was performed at the required frequency, that results are within QC limits, and review associated standards, including initial and continuing calibration standards and blanks. For a subset of the analytes, recalculate the percent recoveries for calibration standards using the data on the Initial and continuing calibration verification summary form and verify that the concentrations reported on this form are consistent with those in the instrument output. For ICVs/CCVs that have percent recoveries outside of control limits and for calibration blanks for which analytes are detected, review the run logs to confirm which samples were affected by out of control CCVs and CCBs. Associated sample results should be qualified as described in the QAPP or USEPA NFGs (2010) though professional judgment and project-specified requirements should be used.

- D. Verify that Interference Check Sample data requirements were met and results are within QC limits. Recalculate a subset of the percent recoveries and review the raw data to verify that the results from the instrument output match those reported on the Interference Check Sample summary form. If the interference check sample results fall outside of the control limits, the associated sample results should be qualified as described in the QAPP or USEPA NFGs (2010).
- E. Verify that ICP serial dilutions requirements were met and results are within QC limits. Recalculate percent differences for a subset of the results and verify that instrument outputs match values reported in the summary form. Where percent differences exceed the control limit and sample results are greater than 50 times the method detection limit, the associated sample results should be qualified as described in the QAPP or USEPA NFGs (2010).
- F. Verify that ICP/MS internal standard requirements were met and results within QC limits. Review raw data and recalculate a subset of the relative intensities of the internal standards and compare them to those reported on the internal standard relative intensity summary form. The associated sample results should be qualified as described in the QAPP or USEPA NFGs (2010).

Qualify all sample data associated with QC or calibration that do not meet the project specifications or QC limit using the appropriate qualifiers as defined in Section 3.4 Data Qualifiers. Use the guidance for data qualification from the project specific guidelines in the QAPP or guidance in the USEPA NFG (2010).

## 5.0 DOCUMENTATION

The data evaluation procedures and results will be documented through completion of a checklist, worksheet or summary document, subject to review and approval by the appropriate project representative(s). The data evaluation documents will be provided to the Project Manager and included in the project file containing the associated laboratory result reports.

Include the project name, project number, laboratory name, laboratory project number, field sample IDs, sample matrix, and analytical parameters and methods used on the data evaluation documentation forms. Specify the relevant project-planning documents and reference the protocol that was used to perform the data evaluation (such as this SOP).

A data review checklist is provided in Attachment A and a data validation checklist is provided in Attachment B. The table in Section 1.3 or list of report contents in Section 4.1 can be used as the basis for a checklist of the data completeness check.

## 6.0 DATA USE

Qualifier flags are assigned to describe the degree to which individual values provide accurate and precise results. The general criteria for assigning flags and their meaning in terms of future data use are as follows:

- Values assigned J flags (J, J+, or J-) are considered estimated results. QC data supplied with those values indicate that they may not be accurate or precise within the limits specified in the QAPP or a project-specific document, but that the magnitude of the potential imprecision or inaccuracy is not great enough to reject the value for project data uses.
- Values assigned R flags do not meet the requirements for accuracy, precision, representativeness, or reproducibility specified to provide quantitative data for the project data uses. The R flag indicates that serious deficiencies were encountered preventing the generation of usable data for the project objectives.
- Values assigned U flags indicate that a concentration of the analyte cannot be confirmed due to the presence of an interferant or the presence of the analyte in associated blanks. UJ flags may be applied to indicate that the presence of the analyte cannot be confirmed and the value of the reported quantitation limit for the sample may not be accurate or precise. Values flagged with U or UJ are fully usable and should be considered undetected.
- Values without flags assigned have met all of the project data quality objectives and are suitable for all project data uses.

## 7.0 QUALITY ASSURANCE/QUALITY CONTROL

The data evaluation documents will be reviewed internally for conformance to the procedures described herein. Once any questions or comments resulting from that

review have been resolved, the data evaluation documents will be considered final and any data qualifiers will be assigned to the results that are ultimately included in the project's electronic database.

## 8.0 REFERENCES

U.S. Environmental Protection Agency (USEPA), 2010. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review. EPA 540-R-10-011. January.

## **STANDARD OPERATING PROCEDURE No. 31**

### **WATER QUALITY METER CALIBRATION**

#### **1.0 SCOPE AND APPLICABILITY**

This Standard Operating Procedure (SOP) describes the protocol to be followed for calibration of the field water quality sampling multi-parameter instrument used during environmental monitoring and sampling activities. The procedures presented herein are intended to be general in nature and are applicable when referenced by site-specific or project-specific planning documents. Appropriate modifications to the procedures may be made to accommodate project-specific protocols when approved in writing or via email by the Project Manager or detailed in a project work plan, sampling plan, or quality assurance project plan.

The objective of calibrating field instruments is to establish the accuracy and reliability of the instrument and to ensure that field readings are consistent with other measurements.

#### **2.0 BASIS FOR METHODOLOGY**

The methods and procedures described in this SOP were developed from this source:

- U.S. Geological Survey (USGS) (variously dated) National Field Manual for the Collection of Water-Quality Data: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Handbooks for Water-Resources Investigations, Chapters A1-A9.

## 3.0 EQUIPMENT AND SUPPLIES

### 3.1 Multi-Parameter Sensors

Multi-parameter sensors can vary between manufacturers of instruments and as technology advances. The following are the sensors generally used on multi-parameter instruments for collecting water quality parameters: water temperature, pH, specific electrical conductance (SC), oxidation-reduction potential (ORP ), and dissolved oxygen (DO). Turbidity is generally measured using a separate meter, but there are some instruments for which the turbidity sensor is included with the multi-meter sensor cluster.

- pH – sensor has a range between 2 to 12, or 0 to 14 pH units
- Water Temperature – sensor has a range of at least -5 to +45 degrees Celsius
- SC – sensor is temperature compensating, and measures in micro siemens per centimeter ( $\mu\text{S}/\text{cm}$ ) or mS/cm
- DO – 2 types of sensors (polarographic and optical) both sensors range from 0.05 to 20 milligrams per liter (mg/L)
- ORP – sensor uses a platinum electrode, and measures in millivolts (mV)

### 3.2 Calibration Supplies

The following supplies are needed to calibrate a multi-parameter instrument: specific sensor buffers, standards, and calibration solutions, field notes, ebooks, deionized water, bucket(s), disposable gloves, scrub brushes, and paper tissues.

## 4.0 CALIBRATION PROCEDURE

The multi-parameter instrument will be calibrated in the field once daily by personnel according to manufacturer's instructions prior to the collection of any samples. All calibration details will be recorded in a field notebook including, but not limited to: instrument type, instrument serial number, readings prior to calibration, buffers used, readings after calibration, names of personnel calibrating, and date and time of calibration. The following are general guidelines to follow when calibrating a multi-parameter instrument:

- A. Follow the manufacturer instructions;
- B. Set the meter to the correct measurement units;
- C. Allow the meter to warm up (at least 10 minutes or according to manufacturer recommendation);
- D. Calibrate the instrument in a temperature-stable environment;
- E. Use the calibration cup for calibration;
- F. Use the recommended volume of calibration solution during calibration;
- G. Do not over tighten the calibration cup;
- H. Rinse the sensor with deionized water prior to the use of calibration solution, then rinse with a small amount of the calibration solution to be used before calibrating; and
- I. Calibrate the meter sensors in the following order: water temperature, SC, DO, pH, and ORP.

#### **4.1 Multi-Point Calibration**

##### **4.1.1 Water Temperature**

Check to ensure the accuracy of the temperature sensor at least every 3 months if the multi-parameter instrument is in frequent use or according to the manufacturer's recommendations. The accuracy of the temperature sensor will be verified against a certified NIST-traceable digital or liquid-in-glass thermometer. Completely submerge the multi-parameter meter temperature sensor and allow at least 1 minute for the temperature to equilibrate and stabilize. Record the temperature value in degrees Celsius (°C). If the difference between the readings does not fall within the manufacturer-specified accuracy, contact the supplier or manufacturer for the next steps.

##### **4.1.2 Specific Conductance (SC)**

Calibration for SC is performed using a one-point calibration. Use the standard recommended by the manufacturer or a standard that is similar in conductivity to the sample water. The calibration cup and sensor will first be rinsed using a small amount of calibration solution prior to the start of calibration. Next the calibration cup will be filled with the recommended volume of calibration solution and the sensor completely

submerged. When the readings stabilize save the calibration point and record in the field notebook the readings before and after calibration in uS/cm.

#### 4.1.3 Dissolved Oxygen (DO)

Follow the manufacturer's guidelines for care, proper setup, and calibration of the DO sensor for the instrument in use. Whenever possible, ensure that the DO sensor has been appropriately calibrated by the instrument supplier or party responsible for maintenance prior to using the instrument in the field.

#### 4.1.4 pH

Calibration of the pH sensor is performed using a two-point calibration. Select the pH 7 buffer as well as a second pH buffer (pH 4 or pH 10) that brackets the expected range of sample water pH. A calibration check using a third buffer can be performed at the end of calibration. To start, the calibration cup and sensor will be rinsed with deionized water and then with a small amount of the first buffer. Next the calibration cup will be filled with enough of the first buffer to completely cover the pH and temperature sensors (the pH value is temperature dependent). Wait for the pH and temperature sensors to equilibrate to the temperature of the buffer and record the temperature reading after stabilization. Adjust the calibration reading (to the true pH value at that temperature) using the chart provided by the buffer manufacturer. Record the temperature and pH readings before and after calibration of the first buffer in the field notebook. Follow the same steps starting with the rinsing of the calibration cup and sensor for the second buffer. If a third buffer is used to check the calibration, follow the same steps, but do not lock in a calibration point.

#### 4.1.5 Oxidation-Reduction Potential (ORP)

Calibration of the ORP sensor is generally performed using a one-point calibration at a known temperature. The manufacturer's recommendation will be followed for calibration. The calibration cup and sensor will first be rinsed with a small amount of the solution. Next fill the calibration cup with enough of the solution to completely submerge the ORP sensor. Wait for the readings to stabilize and then enter the correct value of

the solution at the current temperature. Record the ORP readings before and after calibration in mV, as well as the solution values used in the field notebook.

#### **4.2 One-Point Calibration**

Calibration may be performed using the In-Situ Quick Cal Solution when an In-Situ smarTROLL™ MP handheld water quality meter is used. The Quick Cal Solution performs a one-point calibration of all smarTroll™ MP sensors (pH, ORP, SC, and DO) at the same time. The manufacturer's recommendations will be followed for calibration as well as the following use and storage guidelines:

- Shake well before use;
- Allow to warm to room temperature before using;
- Store in refrigerator (needs to be stored in dark and cool environment);
- Use within three weeks after opening (document on bottle and calibration records when opened);
- Unopened shelf life is six months (check and document expiration date of bottle); and
- One-time use only (i.e. solution should not be re-used following single calibration).

#### **5.0 DOCUMENTATION**

The Project Manager or designated reviewer will check and verify that documentation of instrument calibration has been completed and the calibration records are filed in the project records.

#### **6.0 REFERENCES**

U.S. Geological Survey (USGS), variously dated. National Field Manual for the Collection of Water-Quality Data: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Handbooks for Water-Resources Investigations, Chapters A1-A9. Available online at <http://pubs.water.usgs.gov/twri9A>.

## **Appendix D - HASP**

# **Mayflower Tailings Impoundments Sampling and Analysis Plan**

## **Health and Safety Plan (HASP)**

**May 2015**

Prepared for:

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### **Attachments**

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5	Heat Stress Education Poster
6	Material Safety Data Sheets – Zinc

## **LIST OF ACRONYMS**

COPC	Chemical of Potential Concern
FSP	Field Sampling Plan
GPS	Global Positioning System
HASP	Health and Safety Plan
IDEQ	Idaho Department of Environmental Quality
OSHA	Occupational Health and Safety Association
PPE	Personal Protective Equipment
QAPP	Quality Assurance Project Plan
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedures
SSO	Site Safety Officer
USEPA	United States Environmental Protection Agency
USFS	United States Department of Agriculture Forest Service

## **1.0 INTRODUCTION**

This Health and Safety Plan (HASP) establishes policies and procedures to protect workers from the potential hazards posed by field activities associated with environmental sampling of various media in and around the Mayflower Tailings Impoundments and surrounding area (Site) including the Animas River. The project area is located near Silverton, Colorado (Figure 1).

The HASP assigns personnel responsibilities, prescribes mandatory operating procedures, establishes personal protective equipment (PPE) requirements, and describes actions to be taken during a site emergency. The HASP has been prepared to comply with the requirements of 29 CFR 1910.120 (b)(4) and the requirements of the Environmental Protection Agency (EPA) Occupational Health and Safety Manual. In addition, the EPA Interim Standard Operating Safety Guide will be followed during site activities.

The provisions of this plan are mandatory for all personnel assigned to the project, including all employees of Formation Environmental, and will serve as a guideline for subcontractors and visitors. A copy of this plan will be made available to all personnel, contractors, subcontractors, and authorized visitors that may enter work areas. This plan does not apply to the EPA or State of Colorado personnel or their on-site representatives.

Formation Environmental personnel working at the site must have received the Occupational Safety and Health Administration (OSHA) HAZWOPER training (29 CFR 1910.120(e)(3)) as applicable. HAZWOPER training certificates will be maintained on-site by the Site Health and Safety Officer (SHSO). Those personnel must be involved in the communication and understanding of potential chemical hazards through a Hazard Communication Program in accordance with the provisions of the OSHA Regulations 29 CFR 1910.1200.

This plan also provides for alternative procedures to address changing situations that may arise during field operations. This plan shall be present and readily available during all on-site activities. All personnel working on or visiting work areas shall be briefed on the HASP and adhere to all provisions of this plan. Any supplemental plans used by subcontractors shall conform to this HASP as a minimum.

All project-related personnel on-Site, including contractors, shall be informed of the Site emergency response procedures and any potential fire, explosion, health, or safety hazards of the operation. This HASP summarizes those hazards and defines protective measures.

This plan must be reviewed and an agreement to comply with the requirements must be signed by all personnel prior to performing field work at the Site.

During development of this plan, consideration was given to current safety standards as defined by the EPA, OSHA, and the National Institute of Occupational Safety and Health (NIOSH),

health effects, and standard for known contaminants, and procedures designed to account for the potential for exposure to unknown substances. The following reference sources have been consulted:

- OSHA 29 CFR 1910.120 and EPA 40 CFR 311;
- OSHA/NIOSH/EPA/United States Coast Guard (USCG) Occupational Health and Safety Guidelines;
- NIOSH Pocket Guide to Chemical Hazards; and
- American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values.

This plan has been developed using the historical information and the analytical data available. As additional information is collected, this HASP may be updated to reflect new hazard analysis and new health and safety program requirements.

Overall Hazard is:                    High: \_\_\_\_\_ Moderate: \_\_\_\_\_  
    Low:  Unknown: \_\_\_\_\_

### **1.1 Site Description**

There are four Mayflower Tailings Impoundments and they are located approximately one mile to the northeast and upstream of Silverton on the right bank of the Animas River. As shown on Figure 2, the study area on the Animas adjacent to the tailings impoundments extends from the confluence of the Upper Animas River and Arrastra Creek downstream to the former Lacawana Bridge crossing and includes the major inflows identified by the USGS (Kimball et al., 2010) along this reach of interest. Tailings Impoundment No. 1 is the most upstream, and subsequent impoundments are numbered in the downstream direction. The tailings in the impoundments were generated by flotation milling of gold/silver ore at the Mayflower Mill, located just northeast of Tailings Impoundment No. 1 (Figure 2). The ore was extracted from the Sunnyside Mine (previously the Standard Metals Mine), which was most recently accessed by a haulage tunnel in the Cement Creek basin to the north of Silverton. The Sunnyside Mine and the Mayflower Mill ceased operation in 1991. The Mayflower Tailings Impoundments were reclaimed in the early 1990s by re-grading the side slopes to achieve a stable configuration and by covering the slopes and top surfaces with locally derived soil and rock. Presently the impoundments are dry and support a sparse vegetative cover.

Extensive historic mining and milling activity occurred throughout the upper Animas River basin over the past 150 years, including areas upstream of the Mayflower Tailings Impoundments. Discharging mine adits and historic mine waste rock piles are present at numerous locations, and historic mills typically discharged tailings to the Animas and its tributaries. As a result of the historic mining and milling activities, concentrations of metals such as aluminum, cadmium, iron, manganese, and zinc have historically exceeded their respective Colorado water quality

standards for reach of the Animas River that is within the study area. Elevated metals concentrations in the Animas River have been documented to occur in the vicinity of the Mayflower Tailings Impoundments.

## **1.2 Project Description**

Formation is performing investigational sampling at and around Mayflower Tailings Impoundments. Field activities associated with the sampling will include field measurements of stream flow, drilling and well construction, groundwater level measurements, and collection of groundwater, surface water, and soil samples for subsequent analysis. Details regarding the planned field activities are provided in the Work Plan (Formation, 2015).

## **1.3 Plan Revisions**

The procedures presented herein are intended to serve as guidelines. They are not a substitute for the sound judgment of on-site personnel. Work conditions may change as the project progresses. As appropriate, the plan will be modified by the Project Manager and reissued. Prompt notification of changing work conditions requiring possible modification of this plan is the responsibility of the Project Manager. Additional field tasks with unique hazards or risks may also require changes to this plan. In addition, procedures and equipment specified in this plan will be reviewed and updated as new technologies and equipment are developed. In any event, no changes to this plan will be implemented without prior approval of the Project Manager.

HASP Attachment 1 will be reserved for HASP addenda. The addenda will be identified by letter and will refer to the latest current revision of the plan (e.g., the first addendum to this plan will be Addendum 1A). Each person with a copy of this plan will be provided with each addendum. A list of those persons who have a copy of this plan will be kept by the Field Supervisor.

## **2.0 KEY PERSONNEL**

The names and contact information of key project personnel are shown in Table 1.

**Table 1: Key Project Personnel**

<b>Key Personnel</b>	<b>Name</b>	<b>Affiliation</b>	<b>Work Phone</b>	<b>Other Phone</b>
Project Manager	Brian Hansen	Formation Environmental	303-442-0267	720-635-6911
Field Supervisor	Patrick Lennberg	Formation Environmental	303-442-0267	512-659-2990
Health and Safety Officer	Patrick Lennberg	Formation Environmental	303-442-0267	512-659-2990

### **2.1 Project Manager**

The Project Manager will coordinate all Site activities for the project. The Project Manager will have the responsibility to interface with any regulatory agency personnel and to ensure that appropriate reporting occurs.

The Project Manager's responsibilities include the following:

- Overseeing project implementation;
- Primary point of contact with regulatory agency personnel;
- Decisions of changes to the HASP; and
- Coordinating with the Field Supervisor and Health and Safety Officer on project health and safety requirements.

### **2.2 Field Supervisor**

The Field Supervisor will be designated as the person responsible for oversight of the project implementation, including all health and safety activities. The Field Supervisor will have the responsibility for implementation of the HASP during actual field operations. His responsibilities include the following:

- Conducting the pre-entry briefing with field personnel;
- Informing personnel involved in the field operations of the proper procedures during emergencies;
- Immediately reporting any unusual or unsafe conditions to the Project Manager;
- Verifying that all employees under his or her leadership work in a safe manner according to Sunnyside Gold policies and this HASP;

- Providing a copy of the HASP to all contractors, and informing them or their representatives of any potential safety hazards that exist on-Site or that may be identified during normal operations;
- Observing work party members for symptoms of overexposure or stress;
- Conducting daily tailgate safety meetings;
- Performing Site audits to verify adherence to the requirements of the HASP; and
- Modifying health and safety equipment or procedures based on data gathered at the worksite.

### **2.3 Health and Safety Officer**

The Health and Safety Officer will be supervising for all health and safety activities during the project implementation. The Health and Safety Officer will report directly to the Field Supervisor when sampling activities are occurring if these roles are not undertaken by the same person. Specific responsibilities include:

- Participating in the preparation of and implementation of this HASP;
- Conducting initial briefings for personnel beginning work at the Site. Personnel will supply copies of all training, medical surveillance, and fit testing documentation. Such documentation will be reviewed and maintained by the Health and Safety Officer;
- Available for daily tailgate safety meetings (meetings will be documented [attendees and safety issues discussed] and documentation maintained on-Site). The Daily Pre-Work/Job Site Assessment form is provided as HASP Attachment 2;
- Informing personnel involved in the field operations of the proper procedures during emergencies;
- Ensuring that personnel involved in this project are aware of the provisions of this HASP;
- Informing and reminding personnel of the potential hazards associated with this project;
- Ensuring that field personnel receive Site-specific training the first day on-Site;
- Selecting appropriate protective clothing and equipment;
- Monitoring on-Site intrusive operations and conditions;
- Immediately reporting any unusual or unsafe conditions to the Field Supervisor;
- Coordinating emergency procedures, evacuation routes, and calling the appropriate emergency contacts; and
- Approving this plan and making any updates or changes based on experience at the Site or new data gathered.

### **2.4 Project Staff Responsibilities**

Specific responsibilities for all field personnel involved with the project include:

- Complying with the plan;

- Administering necessary precautions to minimize injury or chemical exposure to themselves or other personnel; and
- Notifying the Field Supervisor or Health and Safety Officer of unsafe or potentially unsafe conditions, as well as of any accidents or injuries.

## **2.5 Contractors**

Contractors and third party contractors shall bear the ultimate responsibility for all matters dealing with safety in the performance of their work. This responsibility includes the safety of all persons and property and any and all employees of contractors that may perform work on their behalf. This requirement will apply continuously regardless of time or place, and will in no way be altered because Formation Environmental personnel provide general directions as to the location where work should be performed and/or samples taken. The contractor, their employees and any and all employees of subcontractors that may perform work on their behalf may be required to work with potentially hazardous substances. The Health and Safety Officer will, to the best of his or her ability, inform contractors or their representatives of any potential electrical, fire, explosion, health, or other safety hazards that have been identified during operations. A copy of this HASP shall be made available to all contractors performing project-related work at the Site.

### 3.0 HAZARD EVALUATION

The major goal of the procedures defined in this HASP is to protect the workers from physical and chemical hazards that may be encountered during implementation of the work. The sections below discuss the hazards that could potentially be encountered during the course of the project. A Job Safety Analysis (JSA) document is provided in HASP Attachment 3. While the attached JSA is specific to work performed in and around streams, ponds, and lakes, the hazards and safe job procedures apply to other environmental monitoring work as well.

#### 3.1 Physical Hazards

Injuries that may result from these physical hazards can range from simple slip-trip-fall types of accidents to casualties, including fatalities due to moving heavy equipment or electrocution. Injuries resulting from physical hazards can be avoided through the adoption of safe work practices and employing caution when working with or near machinery. Never put your hands near moving equipment (e.g., cables, pulleys, or automated hammers).

Additional physical hazards associated with hard rock mine features are, but not limited to, the presence of steep slopes, high walls, and the operation of heavy equipment. Work should be avoided, to the extent possible, in areas where these hazards may exist. In addition, work will be conducted in the vicinity of cold, fast-moving streams. Project personnel should only enter such streams for the purposes of discharge measurements or sampling with the appropriate PPE and safety equipment. Project personnel may decline to enter such streams if they deem conditions to be unsafe.

At the start of each day, the Field Supervisor shall inform the Project Manager of the locations and nature of the planned work. All field personnel shall be conscious of their work environment and should notify the Field Supervisor or other appropriate supervisory personnel of any unsafe conditions. The Field Supervisor will be responsible for informing all workers of any physical hazards related to the Site. All field personnel should also familiarize themselves with other contractors' safety procedures. The protective measures to be implemented during completion of field activities are also identified under Section 5, Personal Protective Equipment (PPE).

##### 3.1.1 Heavy Equipment

Operation of heavy equipment (drilling rigs, graders, compactors, trucks, and dozers) presents a potential physical hazard to personnel. All PPE must meet or exceed the relevant standards set by NIOSH (National Institute for Occupational Safety and Health), ASTM (American Society for Testing and Materials), or ANSI (American National Standards Institute) for safety hard-toed boots, safety glasses or safety sunglasses, and hard hats, all of which should be worn whenever such equipment is present. Personnel should at all times be aware of the location and operation of heavy equipment, and take precautions to avoid getting in the way of their operation. High visibility vests may be appropriate in open areas subject to heavy equipment

traffic. When approaching the operator of any heavy equipment, be sure to make and maintain a clear line-of-sight contact.

### 3.1.2 Trenching/Excavation

Trenches and excavations may pose a physical hazard to Site personnel during the collection of samples for geotechnical and/or laboratory analysis or other field work activities. All trenching and excavation work shall comply with the requirements of 29 CFR 1926, Subpart P. No worker shall enter an excavation without ensuring that the excavation and procedures comply with 29 CFR 1926. The contractor shall train any personnel that may enter an excavation in safe practices. Some requirements for safe trenching are:

- Whenever possible workers will not go into trenches or excavations.
- Any excavations and/or trenches exceeding five (5) feet in depth and in which personnel may be entering must be sloped, shored, braced or otherwise supported. Sloping angles and/or shoring/bracing requirements shall be determined after an inspection of the soils and conditions by a competent individual. The water content of the soil, the soil type, the degree of compaction, superimposed loads and vibration can effect the stability of a trench excavation. Support systems shall be planned and designed by a qualified person.
- Excavations and trenches will be inspected by a competent person before workers enter them. Furthermore, daily inspections shall be made and trenches shall be reinspected after every rainstorm or other hazard-increasing event.
- Excavated materials (spoils) shall be stored at least two feet or more from the edge of the excavation, or otherwise retained, in order to prevent this material from falling into the excavation.
- In locations where oxygen deficiency or hazardous gaseous conditions are possible, air in the excavation or trench shall be tested. Controls shall be established to assure acceptable atmospheric conditions. When flammable gases are present, adequate ventilation shall be provided or sources of ignition shall be eliminated. Attended emergency rescue equipment, such as breathing apparatus, a safety harness and line, basket stretcher, etc., should be easily available where adverse atmospheric conditions may exist or develop in an excavation or trench. A log of all test results shall be maintained.
- When employees are required to be in trenches four feet deep or more, an adequate means of exit, such as a ladder or steps, will be provided and located no more than 25 feet from any work area.

### 3.1.3 Cold Stress

Personnel working outdoors in low temperatures, especially at or below 40° Fahrenheit (F), wet conditions, wind speed 5 miles per hour or higher, lack of water, previous cold injuries, use of tobacco, fatigue and low activity are subject to cold stress. Exposure to extreme cold for a short time causes severe injury to the surface of the body. Areas of the body which have high surface area-to-volume ratio such as fingers, toes, feet and ears are the most susceptible.

Two factors influence the development of a cold injury: ambient temperature and the velocity of the wind. Wind chill is used to describe the chilling effect of moving air in combination with low temperature. A wind chill chart is shown in HASP Attachment 4.

#### *Frostbite*

Local injury resulting from cold is included in the generic term frostbite. Frostbite of the extremities can be categorized as:

- "Frost nip or incipient frostbite" which is characterized by sudden whitening of skin;
- "Superficial frostbite" which is characterized by skin with a waxy or white appearance and is firm to the touch, but tissue beneath is resilient; and
- "Deep frostbite" which is characterized by tissues that are cold, pale, and solid.

#### *Hypothermia*

Hypothermia is most likely at very cold temperatures but it can occur even at cool temperatures if an individual becomes chilled from rain or sweat. Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. Its symptoms are usually exhibited in five stages:

- Shivering, exhaustion;
- Apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95° F;
- Unconsciousness, glassy stare, slow pulse, and respiratory rate;
- Freezing of the extremities; and
- Death.

Field activities shall be terminated by the Health and Safety Officer or Field Supervisor if initial signs of frostbite or hypothermia exist and activities may be terminated if equivalent wind chill temperature is below 0° F. All affected personnel shall be kept warm and receive immediate medical care.

Additional notes to remember:

- Do not rub the frostbitten part;
- Do not use ice, snow, gasoline or anything cold on the frostbitten area;
- Do not use heat lamps or hot water bottles to rewarm the part; and
- Give a warm drink - not coffee, tea, or alcohol.

### 3.1.4 Heat Stress

When personnel are working in hot environments, the Field Supervisor and all field personnel should be trained to recognize the symptoms of heat stress and provide initial first aid treatment if required until more qualified personnel take over. Heat stress occurs when the rate of heat gain is greater than the body's ability to remove it. It is important to understand the factors that cause overheating and mechanisms to control those factors. A heat stress education poster is included as HASP Attachment 5.

Heating of the body occurs from three sources:

- Radiant heating from heat sources or sunlight;
- Convective heating from contact with a warmer object or liquid; and
- Metabolic heating caused by activity.

Cooling occurs through three mechanisms:

- Respiration: Exhaled air is warm. As the body overheats, respiration becomes more rapid;
- Radiation: Heat is released at the surface of the skin. As the body overheats, the superficial blood vessels dilate and allow more heat to be lost; and
- Evaporation: Perspiration is released to the skin surface and evaporates. The skin is cooled by evaporative cooling.

#### *Employee Education*

Heat stress symptoms and treatment are described in Table 2.

**Table 2: Heat Stress Symptoms and Treatment**

CONDITION	COMMON SYMPTOMS	TREATMENT
Slightly elevated body temperature	Body temperature between 99 and 101° F Headache	Drink cool fluids. Rest in cool place until temperature and pulse are below 99° F and 110 beats per minute respectively.
Heat rash	Rash mainly on back	Shower at the end of the shift. Observe for signs of heat exhaustion.
Heat cramps	Muscle cramps or twitching often starting in abdominal area.  Pain in hands, feet and abdominal areas.	Remove from field work. Take off PPE. Encourage consumption of cool fluids designed to replenish electrolytes (e.g., Gatorade). Observe for signs of heat exhaustion.
Heat exhaustion	Body temperature between 99 and 102° F  Headache, weakness Elevated pulse Profuse sweating Pale skin Cool wet/clammy skin Lethargic Nausea Dizziness	Act immediately. Remove to a cool shaded area. Take off PPE. Drink cool fluids, about a cup every 15 minutes unless sick to the stomach.  Spray with a cool mist of water or apply wet cloth to skin. Treat as a medical emergency if the person does not feel better in a few minutes. No field work for at least 48 hours.
Heat stroke  <b>LIFE THREATENING</b>	Temperature greater than 102° F Hot, dry pale skin with no sweating Flushed skin Irritability, confusion, seizures, unconsciousness. Rapid pulse	Treat as a medical emergency. Remove from field work. Remove PPE. Spray with a cool water mist, or apply cool wet cloth to skin, not cold water. Place ice packs under armpits and groin area until emergency medical services arrive. Written release from doctor required to return to work.

### *Effects of PPE*

Heat stress may occur with or without the use of PPE. PPE adds layers of clothing that insulate the wearer from cooling air. Chemical protective clothing generally has a vapor barrier to keep out chemical vapors. The vapor barrier also prevents evaporative cooling of perspiration. In short, PPE increases the heat stress on workers.

### *Practical Methods to Reduce Heat Stress*

These methods will be discussed during safety meetings:

- Become acclimated to heat for several days whenever possible. Plan work in the cooler portions of the day. Early morning hours and evening hours are cooler.

- Perform Site preparations before the field team dresses out. Instrument calibrations, equipment preparation, and planning for the work day, etc., should be performed before dressing in PPE.
- Take frequent breaks and consume at least one pint of cool fluid every hour. Replenish electrolytes through the consumption of diluted drinks. The body loses more water than electrolytes. Concentrated salt, electrolyte, or juices can increase susceptibility to heat stress.
- Avoid beverages with caffeine, which make the body lose water and increase risk for heat illnesses.

#### *Occupational Exposure Standards*

The EPA and the ACGIH have published heat stress monitoring recommendations. The EPA recommends heat-stress monitoring at temperatures above 70° F when chemical PPE is used.

The tabulated information assumes that no chemical PPE is being worn. Since chemical PPE tends to increase heat stress, ACGIH has published correction factors in the same standard. OSHA enforces the ACGIH recommendation.

#### **3.1.5 Weather**

It is a Formation Environmental policy that field work be conducted under safe conditions. Rain, snow and/or high wind conditions may occur during the time period of a scheduled work activity.

Protective clothing for wet conditions will be utilized as necessary. Heavy rains, high winds or other weather conditions may result in the cessation of Site activities, at the discretion of the Project Manager or Field Supervisor.

Outdoor operations will be suspended when lightning is within a 15 second count of the Site (i.e., the time difference between seeing a lightning strike and hearing the sound). High profile equipment operation, such as drill rigs, shall be suspended when lightning is within 30 seconds of the Site. Equipment operators shall stop their equipment and park it safely before heading for shelter. No personnel will be left on the ground in an exposed location. Preferred shelter during thunderstorms is a permanent building. Personnel may also take shelter in trailers or low profile rubber tired equipment (e.g., pickups). Avoid driving pickups or any other equipment, except to help evacuate personnel.

Thunderstorms always have the potential for down bursts and hail. Weather forecasts should be monitored frequently for changing weather conditions. Work may resume after a 30 minute period without lightning occurring within the 15 or 30 second count specified.

The Field Supervisor will ensure that a dedicated watch is posted during periods of tornado watch or warning. Personnel will be evacuated to permanent structure when necessary. During

tornado warnings, refuge should be sought in buildings under archways, tables or in closets below ground level or on the main floors. If the tornado is too close to evacuate to a permanent structure, refuge should be sought in low areas such as ditches.

Extra care must be taken by Site workers during snowy weather. Adequate protective clothing must be donned. Site workers must be allowed rest periods in warm shelters at regular intervals. Vehicle speeds on Site will be limited to below 10 mph during snowy conditions. All work shall be suspended under blizzard conditions and Site workers shall immediately seek warm, sturdy shelters, such as buildings.

### **3.1.6 Noise**

Personnel working around large construction equipment and loud, congested areas can be exposed to excessive noise causing temporary or permanent damage to hearing. The effects of noise can include:

- workers being startled, annoyed, or distracted;
- physical damage to the ear; and
- impediment to communication that may increase potential hazards.

All personnel shall wear hearing-protective devices (i.e., either ear plugs or muffs) when noise levels interfere with normal speech. Hand signals will be established by on-Site personnel, as appropriate, to facilitate communications while involved in high-noise activities.

### **3.1.7 Dangerous Animals, Insects, and Plants**

The Mayflower Tailings Impoundments are in a high-altitude, mountainous setting. In warm months, workers must be prepared for mosquitoes, ticks, chiggers, yellow jackets and other insects, and for snakes. At the end of the workday, workers should check their legs and scalp for ticks or other insects.

Animal bites and insect stings are usually nuisances (i.e., localized swelling, itching, and minor pain) that can be handled with first-aid treatments. The bites of certain snakes and spiders contain sufficient poison to warrant medical attention. There are diseases that can be transmitted by insect and animal bites. Examples are Lyme disease (tick), rabies (mainly dogs, skunks and foxes), malaria, and equine encephalitis (mosquito). The greatest hazard and most common cause of fatalities from animal bites, particularly from bees, wasps, and spiders, is a sensitivity reaction. Anaphylactic shock due to stings can lead to severe reactions in the circulatory, respiratory, and central nervous systems, which can also result in death.

The project Site is located in geographic area where Lyme disease and rabies are possible. Lyme disease is spread primarily by a very small tick – the deer tick. It can be found near wooded areas, tall grass and brush. Although the disease is rarely fatal, it can cause flu-like

symptoms, arthritis, heart arrhythmias, facial palsy, severe headaches, and loss of sensation. Protection against the tick consists of wearing clothing that covers the whole body, tucking pant legs into boots or socks and tucking a long-sleeve shirt into pants. A white Tyvek is recommended for protection. Use of repellents containing DEET is also effective. It is also important to frequently check for the ticks, which are about the size of a period on this page. Some warning signs include a "bull's eye" rash that may appear days to weeks after the bite, flu-like symptoms, swelling and pain in joints and, less common, heart arrhythmia, weakness in legs, facial paralysis and numbness. If employees feel they may have contracted the disease, they must notify the Health and Safety Officer.

The most dangerous toxic effects from plants are due to ingestion of nuts, fruits, or leaves. Consequently, personnel are prohibited from eating any fruits, nuts, or other plant material, which may grow on the Site. Of more concern to response personnel are certain plants including poison ivy, poison oak, and poison sumac, which produce adverse effects from direct contact. The usual effect is dermatitis, an inflammation of the skin. The protective clothing and decontamination procedures used for chemicals reduce the exposure risk to the plant toxins. Cleaning the skin thoroughly with soap and warm water immediately after contact will reduce risk.

### **3.1.8 Manual Lifting**

Activities may require personnel to move large, heavy objects by hand. The human body is subject to severe damage in the forms of back injury and hernia if caution is not observed when handling, lifting, or moving large heavy objects.

General Rules:

- Get a good footing;
- Place feet about one shoulder width apart;
- Bend at knees to grasp weight;
- Keep the back straight; and
- Get a good hold.

### **3.1.9 Slip, Trip, and Fall Hazards**

Protection from slip, trip and fall hazards will be provided through standard safety procedures including good housekeeping. Removing equipment and debris, and taking general precautions during Site operations will be standard operating procedures. Workers will be apprised of any potential trip hazards through regularly scheduled health and safety meetings. Whenever possible, trip and fall hazards will be eliminated or clearly identified with yellow "caution" tape. Impalement hazards to workers will be neutralized as soon as they are identified.

### 3.1.10 Proximity to Water

Field activities on or near ponds, fast-moving streams, or other surface waters pose a potential drowning hazard. The hazard is addressed in 29 CFR 1926.106: "Employees working over or near water, where the danger of drowning exists, shall be provided with U.S. Coast Guard-approved life jackets or buoyant work vests." Workers working over water in boats will be required to don a life vest. Workers working near water will not be required to wear life vests; however, life vests will be available within 50 feet of the work activity. Procedures specified in the JSA (see HASP Attachment 3) will be followed for work in and around water.

### 3.1.11 Overhead Utilities

Before Site activities begin, all overhead utilities will be identified and field verified. As necessary, utilities will be deactivated, or operational procedures and project logistics will be established to avoid overhead lines. This will be the responsibility of the Field Supervisor. The contractor(s) will be responsible for operation of equipment in a safe manner and follow the relevant regulations of 29 CFR 1926.952. These regulations include, but are not limited to:

- All electrical equipment shall be de-energized;
- Assume that all overhead lines are energized unless de-energized by the person owning the line or the electrical utility authorities indicate that it is not an energized line and it has been visibly grounded.
- No hoisted loads shall be left unattended.

These regulations require all operating equipment maintain minimum safe operating distances from overhead power transmission lines as given in 29 CFR 1926.950 (Table 3).

**Table 3: Minimum Safe Working Distances (Alternating Current)**

Voltage Range (phase to phase) (kilovolt)	Minimum Working and Clear Hot Stick Distance (Stick Distance)
2.1 to 15	2 feet 0 inches
15.1 to 35	2 feet 4 inches
35.1 to 46	2 feet 6 inches
46.1 to 72.5	3 feet 0 inches
72.6 to 121	3 feet 4 inches
138 to 145	3 feet 6 inches
161 to 169	3 feet 8 inches
230 to 242	5 feet 0 inches
345 to 363	7 feet 0 inches <sup>1</sup>
500 to 552	11 feet 0 inches <sup>1</sup>
700 to 765	15 feet 0 inches <sup>1</sup>

The deactivation of utilities, when necessary, should be certified by the proper utility company personnel and the certification record retained.

### **3.1.12 Underground Utilities**

Before excavation activities begin, all utilities (i.e., electricity, natural gas lines, water lines, sewer lines, etc.) should be identified and deactivated as needed. The location of field work should be adjusted to avoid active underground utilities, if possible. The deactivation of utilities, when necessary, should be certified by the proper utility company personnel and the certification record retained. Location of the utilities and any deactivation will be the responsibility of the Field Supervisor.

### **3.1.13 Fire Prevention**

Fire extinguishers shall be provided in the field vehicle and shall be available on-Site. All extinguishers will be inspected, serviced, and maintained. Inspections shall be recorded on the inspection tag attached to each extinguisher.

### **3.1.14 Traffic**

Vehicle traffic will maintain a safe speed while operating on Site. Occupants of any vehicle shall wear seatbelts at all times. Vehicles and equipment will be equipped with the safety procedures outlined in 30 CFR Subparts H and M and, as applicable, 29 CFR 1926.601. Precautions will be made to warn foot traffic or other vehicles as necessary.

## **3.2 Chemical Hazards**

Potential chemical hazards related to field sampling activities are relatively minor. The data collection activities will include sampling of both surface water and groundwater, soil, and possibly vegetation, and biota that may contain elevated concentrations of metals.

Results from previous sampling performed at the Site indicate that contaminant hazards may be encountered at the Site during field activities. In general, chemical substances in gaseous, liquid, or solid form can enter the unprotected worker by inhalation, skin absorption, ingestion, or through a puncture wound (injection). A contaminant can cause damage at the point of contact or can act systemically in different parts of the body.

In general, chemical exposure by inhalation is a concern since the lungs are extremely vulnerable to chemical agents. In addition, substances can pass through lung tissue into the bloodstream and onto other susceptible areas of the body. Since some toxic chemicals are not detectable by human senses, their toxic effects may not produce any immediate symptoms. Respiratory protection is therefore extremely important if there is a possibility that the worksite atmosphere may contain such hazardous substances.

The skin and eyes also represent important routes of exposure. Some chemicals directly affect the skin, while others may pass through the skin into the bloodstream where they can be transported to other vulnerable organs. Skin absorption is enhanced by abrasions, cuts, heat, and moisture. The eye is particularly vulnerable because airborne chemicals can dissolve on its moist surface and be carried to the rest of the body via capillaries located very close to the surface of the eye. Protection against skin and eye contact may be provided by:

- Wearing protective equipment (i.e., Tyvek coverall suits);
- Wearing protective safety glasses or goggles;
- Avoiding the use of contact lenses in contaminated atmospheres since they may trap chemicals against the eye surface;
- Keeping hands away from the face; and
- Minimizing contact with liquid and solid chemicals.

Inadvertent ingestion can occur as a result of personal habits such as chewing gum or tobacco, drinking, eating, smoking cigarettes, and applying cosmetics. These practices may provide a route of entry for chemicals and are restricted.

#### *Zinc Exposure Limits and Health Effects*

Permissible Exposure Limit (PEL) – 5 mg/m<sup>3</sup> (8 hour workday)

The PEL is the maximum average time weighted concentration of a substance that a worker can be exposed to over a workday.

Action Level – 2.5 mg/m<sup>3</sup> (8 hour workday)

OSHA does not at this time have a specific action level for zinc. Thus the action level is half the PEL. The action level is a time weighted average that indicates the level at which medical surveillance or increased industrial hygiene monitoring is required for a given substance.

Threshold limit value (TLV) – 2 mg/m<sup>3</sup>

The TLV is a time-weighted average concentration for a normal 8-hour workday or 40-hour workweek to which nearly all workers may be repeatedly exposed.

Exposure to zinc in dust can result in headache, fever, weakness and sore throat. As described above, zinc is present in seep and river water and inhalation is not expected to be a significant pathway. Additional information on health effects from exposure to zinc is provided in HASP Attachment 6.

Threshold Limit Values-Time Weighted Average (TLV-TWA) values are the time-weighted average concentration for a normal 10-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect. Threshold Limit Value-Short Term Exposure Limit (TLV-STEL) values are the concentrations to which workers can be exposed intermittently for short periods of time (15 minutes or less) without suffering from: 1) irritation; 2) chronic or irreversible tissue damage; or 3) narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue or materially reduce work efficiency, and provided that the daily TLV-TWA is not exceeded. TLV-TWAs are established by the American Conference on Governmental Industrial Hygienists (ACGIH, 1995) and provide the basis for safety regulations of OSHA. The Immediately Dangerous to Life and Health (IDLH) limit (OSHA) is defined as an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

Other contaminants may be encountered during the course of the Site activities. If unusual odors or conditions are encountered, personnel should suspend work activities and contact the Field Supervisor for guidance before proceeding.

### 3.2.1 General Precautions

If signs of contamination different from those addressed in this HASP are encountered, such as visible soil stains or unusual odors, stop all work in the area, barricade or otherwise isolate the area, and immediately contact the Project Manager. Protection of worker health and safety shall be the first priority. Continuation of work in the area and the amount of additional personal protective equipment, if any, shall be determined by the Project Manager. Other precautions to be undertaken to provide a safe work place on this project where the potential for chemical exposure may exist include:

- No smoking, eating, or drinking in areas where contaminants may be present.

## 4.0 PERSONNEL TRAINING REQUIREMENTS

Prior to initiation of Site activities, all Formation Environmental field personnel shall have completed a 40 hour Hazardous Materials Health and Safety Course and 8-hour annual refresher course(s), as appropriate. All field personnel shall have a minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor.

Compliance with sample collection Standard Operating Procedures (SOPs), as provided in the Field Sampling Plan, is required for all personnel performing assigned tasks. In addition, as applicable, JSA (Job Safety Analysis) documents (see HASP Attachment 3) are a tool to help workers identify potential hazards and safe work practices to address those hazards, thereby, avoiding accidents.

The Field Supervisor shall have completed at least eight additional hours of specialized supervisor training as per 29 CFR 1910.120 (e)(4). All courses shall have been conducted by a qualified trainer as specified in 29 CFR 1910.120 (e)(5). These courses should cover chemical hazards, hazard recognition, hazard assessment and personal protective equipment. If necessary, the Site Health and Safety Officer will have been trained in standard first aid measures and CPR.

All personnel who may participate in the Site activities shall be required to have completed appropriate training as specified in 29 CFR 1910.120 (e)(3). The supervisor-training requirement may also apply to the contractor supervisors. If needed, the contractor shall provide copies of written certificates documenting said training. Copies of training certificates for on-site personnel will be kept at the Site in the possession of the Field Supervisor.

Prior to the initiation of each phase of field work, all personnel and contractors who will participate in the work shall attend a pre-entry briefing. The pre-entry briefing will review information contained in this HASP, including:

- Names of personnel responsible for Site safety and health;
- Safety and health concerns, including physical and chemical hazards present at the Site;
- Use of personal protective equipment;
- Work practices by which the employee can minimize risks from hazards;
- Engineering controls and safe use of equipment on Site;
- Medical surveillance requirements, including recognition of symptoms and signs which might indicate overexposure to hazards;
- Site control measures;
- Site decontamination procedures;
- Emergency response procedures; and

- Spill containment procedures.

In addition, all persons participating in field activities shall be required to read this HASP. Information discussed at the pre-entry briefing will be reinforced, in turn, during tailgate safety meetings (see below). Additional pre-entry briefings may be required for additional phases of work or if new personnel are assigned to the project.

Tailgate safety meetings will be conducted as necessary, or whenever new personnel arrive and/or when a unique work assignment warrants employee training. Tailgate safety meetings will be conducted by the Field Supervisor. These meetings will cover the projected work for the day or the specific task and will review and reinforce good safe work practices (e.g., proper protective clothing, effective deterrents of heat stress, etc.). Information discussed at the tailgate safety meetings may be revised and updated, based on any new data obtained pertaining to Site characterization and analyses. The Daily Pre-Work/Job Site Assessment form is provided as HASP Attachment 2.

## 5.0 PERSONAL PROTECTIVE EQUIPMENT

### 5.1 Personal Protective Equipment Levels

The following sections describe the anticipated levels of personal protection for field work at the Site. These levels are based upon the physical and chemical hazards at the Site, and previous experience at similar locations with similar chemicals of potential concern.

The following minimum PPE requirements will apply:

- Workers engaged in the active large-scale excavation or grading (drilling oversight personnel, grader operators, ground crew/spotters, and dozer operators) will wear Level D protection.
- Workers engaged in water, soil, and/or biota sampling activities will wear modified Level D protection.
- Support workers (supervisors, observers etc.) will wear Level D protection.

The level of personal protection worn by field personnel will be defined, controlled, and implemented by the Field Supervisor. Protection may be upgraded or downgraded by the Project Manager, as deemed necessary throughout the project. Required PPE items include the following: hardhats, hard-toed boots, safety glasses, and hearing protection. Additional safety items to be maintained in each vehicle include, but are not limited to: chock block, 2-way radio, lights/flags, cones, spill kit, fire extinguisher, and first aid kit. Other PPE and safety items may be required depending on conditions and safety procedures specified by the mine.

#### 5.1.1 Level C Personal Protection

- Disposable Tyvek® coveralls (exchanged when heavily soiled or after breaks, at least once per work day);
- Work gloves (disposable nitrile or cotton, depending on task);
- Approved NIOSH safety hard-toe work boots (conforming to ANSI Standard Z 41.1);
- Hard hats (conforming to ANSI Standard Z 89.1);
- Safety goggles (conforming to ANSI Standard Z 87.1);
- Hearing protection (when excessive noise is present); and
- Full-face or half-face respirator with a high efficiency particulate air (HEPA) cartridge filter (conforming to ANSI Standard Z 88.2).

#### 5.1.2 Modified Level D Personal Protection

Modified Level D personal protective equipment may include the following:

- Blue jeans or natural fiber pants, long sleeve natural fiber shirt;
- Work gloves (disposable nitrile or cotton, depending on task);

- Approved NIOSH safety hard-toe work boots (conforming to ANSI Standard Z 41.1);
- Hard hat (conforming to ANSI Standard Z 89.1);
- Safety glasses or sunglasses (conforming to ANSI Standard Z 87.1);
- Orange traffic safety vest;
- Hearing protection (when excessive noise greater than 85 dBA is present); and
- Disposable Tyvek coveralls (exchanged when heavily soiled or after breaks, at least once per work day).

### **5.1.3 Level D Personal Protection**

Level D personal protective equipment is basic and includes the following:

- Blue jeans or natural fiber pants, long sleeve natural fiber shirt;
- Work gloves;
- Approved NIOSH safety hard-toe work boots (conforming to ANSI Standard Z 41.1); and
- Hard hat (conforming to ANSI Standard Z 89.1).
- Safety glasses or sunglasses (conforming to ANSI Standard Z 87.1)

### **5.2 PPE Deviation/Modification**

Protection levels may be upgraded, downgraded, or modified as deemed necessary by the Project Manager based upon work task or Site-specific, safety-related factors such as:

- When excessive noise levels exceed 85 dBA;
- Change of season/weather;
- When temperature extremes or individual medical considerations (i.e., heat stress, medication, etc.) limit the effectiveness of PPE; or
- Contaminants other than those previously identified are encountered.

### **5.3 Limitations of PPE**

PPE ensembles designated for use during work tasks have been selected to provide protection against contaminants at known or anticipated concentrations in soil or water matrices. However, no protective garment, glove, or boot is chemical-proof, nor will it afford protection against all types of chemicals. Permeation of a given chemical through PPE is a complex process governed by contaminant concentrations, environmental conditions, physical condition of the protective garment, and the resistance of a garment to a specific contaminant. Chemical permeation may continue even if a garment is resistant to a specific contaminant and may continue even after the source of contamination has been removed from the garment.

In order to obtain optimum usage from PPE, the following procedures are to be followed by all Site personnel using PPE:

- When using disposable Tyvek coveralls, don a clean, new garment after each rest break or at the beginning of each shift;
- Inspect all clothing, gloves, and boots both prior to and during use for:
  - Imperfect seams;
  - Nonuniform coatings;
  - Tears; and
  - Poorly functioning closure.
- Inspect reusable garments, boots, and gloves both prior to and during use for:
  - Visible signs of chemical permeation;
  - Swelling;
  - Discoloration;
  - Stiffness;
  - Brittleness;
  - Cracks;
  - Any sign of puncture; and
  - Any sign of abrasion.
- Reusable gloves, boots, or coveralls exhibiting any of the characteristics listed above will be discarded. PPE used in areas known or suspected to exhibit elevated concentrations of contaminants will not be reused and will be discarded.

#### **5.4 Donning of PPE**

A routine will be established and followed at the Site for donning PPE. The procedures will be discussed in detail during the Site safety meeting before starting the project and briefly during periodic Site safety meetings.

Before wearing any level of PPE, it will be checked that it is in proper condition for the purpose for which it is intended. Also, workers with any minor injuries and/or openings in the skin surface, such as cuts and scratches, will be attended to in order to protect such areas which may potentially enhance exposure effects. Workers with large cuts, rashes, or other such skin damage will not be allowed to don PPE.

#### **5.5 Medical Surveillance Requirements**

Contractors will be required to have medical surveillance programs that comply with 29 CFR 1910.120 (f). This program requires annual medical monitoring (including pulmonary function

evaluation) for all field personnel. Records for this program are kept in compliance with the requirements of 29 CFR 1910.120. These records include:

- The name and social security number of the employee;
- Physician's written opinions, recommended limitations, and results of examinations and tests;
- Any employee medical complaints related to exposure to hazardous substances; and
- A copy of the information provided to the examining physician by the employee.

## 6.0 SITE CONTROL MEASURES

The Site control measures program is designed to minimize the exposure of personnel to potentially hazardous substances and/or situations. In this section, the term "site" refers to the immediate work area. This objective will be accomplished by the establishment of work zones, the proper decontamination of personnel and equipment, and proper maintenance of safety equipment.

Exclusion Zone: The area where contamination is either known or likely to be present, or because of activity, will provide a potential to cause harm to personnel. Entry into the exclusion zone requires the use of personal protective equipment. The exclusion zone for this work is the area in a 50-foot radius from any excavating, demolition, or trenching equipment and areas where lining activities are occurring.

Decontamination Zone: Personnel performing equipment decontamination will wear personal protective gear. Specific procedures for personnel decontamination are outlined under Section 4.8, Decontamination Plan. The contamination reduction zone will be set up adjacent to each exclusion zone.

Support Zone: The area situated in clean areas near the work areas.

The following general safe work practices will apply during site activities:

- All on-site personnel and any visitors to the site during work activities described in this HASP shall read and sign this safety plan prior to entering and/or working on the site. The master copy (with signature sheet) of this safety plan will be held by the Health and Safety Officer.
- No project personnel may be allowed on-site without the prior knowledge and consent of the designated Field Supervisor.
- Project personnel shall bring to the attention of the Field Supervisor or Health and Safety Officer any unsafe condition or practice associated with on-site project-related activities.
- Personnel will not eat, chew gum or tobacco, smoke, take medicine or perform any other practice that increases the likelihood of hand-to-mouth transfer of potentially hazardous substances from gloves, unwashed hands or equipment.
- No one is to carry "strike-anywhere" matches or cigar/cigarette lighters.
- Personnel will stand upwind of all intrusive activities involving disturbance of the ground surface (e.g., drilling).
- Dust control measures should be instituted if visible dust is created during excavation and other on-site activities by moving all personnel upwind or laterally from the dust source, and by misting the dust source with a water spray.
- Hands, face, and all other potentially contaminated areas shall be thoroughly cleaned prior to eating or leaving the site.

First aid supplies and drinking water will be located on-site.

## **6.1 Decontamination Plan**

### **6.1.1 Personnel Decontamination**

Decontamination and maintenance of personal protective equipment is required for proper functioning of the equipment. At a minimum, nitrile gloves and Tyvek coveralls shall be replaced daily or after breaks; if they become damaged, they shall be replaced immediately.

The decontamination areas will be established prior to initiation of field activities, and the exact decontamination procedures will be established at that time based on field conditions, space considerations, etc. In general, dry equipment doffing procedures will be used (i.e., protective equipment will be removed and containerized without water washing). Respiratory protection equipment will be removed only after all soiled coveralls and gloves have been removed and containerized. Respirators will then be removed and cleaned with soapy water, followed by washing of hands and faces with soapy water. The above decontamination procedures apply only to activities where Level C (if needed on the project) and Modified Level D PPE are required (e.g., intrusive activities). For other activities, such as walk arounds or Site visits, a less rigorous decontamination procedure may be practiced, such as a thorough dry scrubbing of boots, etc.

### **6.1.2 Equipment Decontamination**

Equipment decontamination will not be required during the project, because contaminant levels are low and associated with spring and seep water.

## **6.2 Emergency Response/Contingency Plan**

The required elements of an emergency response plan as specified in 29 CFR 1910.120(1) are listed below. As described in the regulation, many of these items primarily pertain to emergency responses at uncontrolled hazardous waste sites, and thus are not entirely applicable to the anticipated Site activities, which do not constitute an emergency response situation. Any on-Site contractors will be responsible for providing an emergency response plan for their activities. An explanation of how each plan element will be implemented at the Site is provided below:

- 1) Pre-emergency planning - This emergency response plan will be provided to all personnel, including contractor personnel, working on the Site during the pre-entry briefing. In addition, emergency response actions will be reviewed with all personnel during the pre-entry briefing and the tailgate safety meetings.
- 2) Personnel roles, lines of authority, and communication - The Field Supervisor will be responsible for emergency coordination at all times. Any accidents and/or injuries shall immediately be reported to him or her. The Field Supervisor will immediately report any accidents to the Project Manager.

- 3) Emergency recognition and prevention - Physical and chemical hazards at the Site will be reviewed at the pre-entry briefing and the tailgate safety meetings.
- 4) Safe distances and places of refuge - Should emergency conditions arise requiring Site evacuation, the Field Supervisor will notify all on-Site personnel immediately through the use of hand signals and verbal instructions.
- 5) Evacuation routes and procedures - The Field Supervisor will notify all on-Site personnel of the need for immediate evacuation. Site evacuation will be performed in an orderly fashion under the direction of the Field Supervisor.
- 7) Emergency decontamination procedures - In the event of a medical emergency, personnel decontamination prior to medical treatment may be omitted. Whenever possible, Formation personnel will accompany contaminated victims to the hospital to provide advice on matters involving decontamination. If on-Site first aid is rendered and the victim does not require transport to the hospital, clothing and equipment decontamination as described in Section 1.8 will be performed after first aid measures have been performed.
- 8) Emergency medical treatment and first aid - Based on the severity of the injury/exposure, additional medical treatment will be obtained as described in paragraph 9 below.
- 9) Emergency alerting and response procedures - The procedures listed below will be used in the event of any Site emergency:
  - a) Remove any injured person(s) from immediate danger and administer first aid as needed.
  - b) The Field Supervisor will carry a cell phone that provides communication to emergency personnel (911). Field workers will also carry cell phones at all times to allow contact with mine Field Supervisor or emergency personnel. Any medical incidents are to be reported to the Field Supervisor, and Project Manager immediately.
  - c) The nearest medical facility is the Mercy Regional Medical Center in Durango, CO. Driving directions to the hospital are presented in Figure 3.
  - d) Notify Project Manager before resuming work.
- 10) Critique of response and follow-up - Any accidents or emergency incidents shall be reported to the relevant local, state and federal agencies by Sunnyside Gold. The report will include a summary of the emergency, a description of the conditions that led to the emergency, a review of the response actions implemented following the emergency and a discussion of steps that might have been taken to prevent a recurrence of the emergency.

The Project Manager will coordinate with the Field Supervisor, the Health and Safety Officer and other appropriate Sunnyside Gold personnel on follow-up reporting.

- 11) PPE and emergency equipment - All personnel will be required to have complete Level D, and Modified Level D PPE ensembles available for use when on Site. In addition, the Field Supervisor will have available a first aid kit, a fire extinguisher and possibly a portable eyewash kit.

### **6.3 Confined Space Entry Procedures**

No confined space entry is anticipated during Site activities.

### **6.4 Spill Containment Program**

Hazardous substance releases will be controlled and managed in accordance with Federal and State regulations. Water from decontamination efforts will be contained and allowed to evaporate. A spill kit will be included in each vehicle to facilitate early response actions to any substance releases.

### **6.5 Hazard Communication**

The Hazard Communication Act (29 CFR 1910.1200), commonly referred to as the "Worker Right to Know Act", was instituted by OSHA to reduce illness and injury caused by chemical exposure in the workplace.

Formation will inform its employees of potential hazards associated with chemicals brought to the Site to perform various field activities. The information will be distributed in the form of Material Safety Data Sheets (MSDSs). Copies of the MSDS for each chemical brought to the Site will remain on Site during the period that the chemical is being utilized. Safe handling practices and emergency first aid for each chemical will be discussed during the pre-entry briefing, tailgate safety meetings, etc.

## **7.0 HEALTH AND SAFETY PLAN REFERENCES**

American Conference on Governmental Industrial Hygienists (ACGIH), 1995. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices for 1995-1996: Cincinnati, OH.

## **FIGURES**

**ATTACHMENT 1  
PLAN ADDENDA**

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**ATTACHMENT 2**  
**DAILY PRE-WORK/JOB SITE ASSESSMENT FORM**

**Daily Pre-Work/Job Site Assessment  
Environmental Sampling**

Date: \_\_\_\_\_ Performed by: \_\_\_\_\_ Title: \_\_\_\_\_

Brief Description of Assigned Task (s):

Work Area Inspection:	Acceptable		Describe actions taken to correct any deficiency:
	Yes	No	
1. Slope safe compared to where workers are located. 2. Work performed adjacent to mining activities. 3. Ground conditions safe to begin work. 4. Safe access provided to all work areas. 5. Hazardous materials stored properly. 6. Project materials stored safely. 7. Barricades & warning signs adequate. 8. Workers wearing appropriate PPE. 9. First aid, fire extinguishers, radios and special PPE readily available. 10. Power/hand tools, machinery and equipment meet safety standards.			

\*Parts of the inspection can be done by designees.

Hazard Assessment of Assigned Task(s): [Note Hazard & Control Method]

Time of "pre-job" briefing: \_\_\_\_\_

Attendees:

Additional Comments:

**ATTACHMENT 3**  
**JSA – JOB SAFETY ANALYSIS**

## Field Monitoring – In and around streams, ponds, lakes

Sequence of Basic Job Steps	Potential Accidents or Hazards*	Recommended Safe Job Procedures
Prepare for site visit, identify PPE needs, ensure field crew has appropriate safety training	N/A	Familiarize self with site prior to visit, including terrain and potentially hazardous water flows and temperatures. Prepare Health and Safety Plan (HASP), ensure field crew has reviewed HASP and are aware of potential hazards. Ensure at least one or more member of each field crew is First Aid-trained. Inspect all PPE and equipment and ensure that it is working properly.
Assess weather conditions to be encountered during site visit	Heat exposure Sun exposure Cold exposure (dry and wet)	Familiarize self with signs of heat related illnesses: cramps, heat rash, dehydration, heat exhaustion, and heat stroke.  Keep body protected; wear sunscreen, sunglasses or safety glasses, wide-brimmed hat or hardhat (depending upon PPE requirements), proper clothing. Ensure adequate fluid intake.  During cold weather - layer clothing and wear wind impervious outerwear; during warm months – wear a long sleeve cotton/breathable fabric shirt and pant.  In water work – wear appropriate waders and boots, gloves and outer wear to reduce cold and wet exposure.
Carry and load sample coolers and equipment	Slip/Trip/Fall Muscle strains	Employ proper ergonomics when lifting; Get help from a coworker to carry and load coolers and other equipment.
Travel to and from site	Moving vehicles on road or in parking areas  Traffic hazards  Slip/Trip/Fall  Vehicle contact with fixed or movable objects	Be attentive to outside conditions when entering or exiting vehicle.  Secure equipment load to avoid shifting.  Follow defensive driving practices.  Reduce speed on surfaces suspected of being slippery due to ice, rain or other conditions.
Conduct visual inspection of site conditions	Animals, stinging insects, ticks, sharp objects (wire, fence,	Identify areas where biological hazards may be present; wear insect repellent

	<p>protruding branches or sharp rocks);</p> <p><b>Slip/Trip/Fall</b></p> <p>Haul Trucks and other heavy equipment</p>	<p>on exposed skin surfaces; wear long sleeve shirt and full length pants; avoid high grass areas if possible; tuck pants leg into boot; do not put hand/arm into/under an area that you cannot see into/under clearly.</p> <p>Avoid fences if possible, or use help to move through fenced areas to avoid scrapes, cuts abrasions. Wear gloves when opening/closing gates to protect against splinters and barbs.</p> <p>Be sure of footing (wet/muddy conditions may exist, loose rock may be present, sage brush or other woody materials may be present with protruding branches).</p> <p>Where site is on or near mine property, be aware heavy equipment that may be operated nearby. Follow appropriate site-specific safety precautions when parking (use chocks), travelling (wear seatbelts), or working near or on the mine site.</p>
Lifting heavy objects (generators, sampling equipment, coolers, 5-gallon buckets, totes, etc.)	Muscle strain	Use proper ergonomics when lifting heavy objects; use two people to lift gear and equipment as needed based on weight to be lifted.
Donning and doffing waders	Slip/Trip/Fall	Donning and doffing waders to be done on stable ground or a sitting position to avoid losing balance.
Sampling including retrieval of surface water and sediment samples, and flow measurement	<p>Contaminated media</p> <p>Eye/skin contact with biological agents and chemicals</p> <p>Inhalation of chemical vapors (preservatives)</p> <p>Dangerous animals and vegetation</p> <p>Heat exhaustion and sun exposure</p> <p>Hypothermia/cold water exposure</p> <p>Stinging insects</p> <p><b>Slip/Trip/Falls</b></p> <p>Muscle and soft tissue injury</p> <p>Drowning</p>	<p>Wear site/activity-appropriate PPE; Review and understand MSDS for all chemicals being handled. Be careful when handling acids and caustic substances. Wear adequate PPE and wash hands after completion of task.</p> <p>Position body in order to minimize downwind exposure.</p> <p>Be aware of surroundings. Learn to identify, and avoid, toxic plants such as poison ivy. Watch for dangerous animals, such as aggressive dogs on private property, badgers, and harmful insects.</p> <p>Be aware of animal burrows, uneven, and/or loose terrain.</p> <p>Avoid dehydration, excessive sun and heat exposure, wear hats, sunglasses and sunscreen. Wear appropriate PPE for site conditions.</p>

		<p>Wear waders and non-skid wading boots. Where water depths exceed on average waist-deep for an individual, wear a personal flotation device (PFD). Wear wading belt, securing fastener at waist, to minimize filling waders in case of submersion. If a worker does not feel comfortable about the velocity of the river water, do not enter. Fast-moving water could result in a fall and subsequent risk of drowning.</p> <p>Avoid muddy and/or steep banks when entering or exiting the water. If necessary, use a buddy system to aid entrance and exiting water.</p>
Icing (reicing) sample coolers, transporting coolers and other equipment back to laboratory	Slip hazard Muscle and back Injury	Use due care when draining water from coolers, use proper ergonomics when lifting and moving coolers and other equipment.
Site exit	Contaminated vehicle	Wash hands promptly. Used disposable PPE should be disposed on-site. If excess mud or debris is present on truck, wash before leaving mine site.
Drive home or to next site	Traffic hazards	FOLLOW "TRAVEL TO SITE" PROCEDURES

**ATTACHMENT 4**  
**WIND CHILL CHART**

# Wind Chill Factor

Actual air temperature °F

calm    40    30    20    10    0    -10    -20    -30    -40

Apparent temperature

10	34	21	9	-4	-16	-28	-41	-53	-66
20	30	17	4	-9	-22	-35	-48	-61	-74
30	28	15	1	-12	-26	-39	-53	-67	-80
40	27	13	-1	-15	-29	-43	-57	-71	-84
50	26	12	-3	-17	-31	-45	-60	-74	-88
60	25	10	-4	-19	-33	-48	-62	-76	-91

Frostbite times:

30  
minutes

10  
minutes

5  
minutes

National Weather Service (NWS) Wind Chill Chart adapted May 2004 from  
<http://www.nws.noaa.gov/om/windchill/>

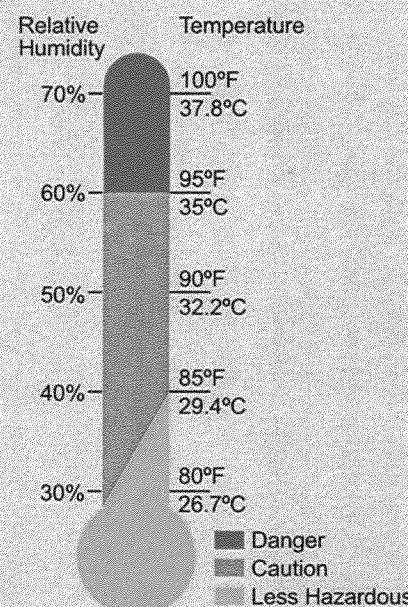
**ATTACHMENT 5  
HEAT STRESS EDUCATION POSTER**



## The Heat Equation

HIGH TEMPERATURE + HIGH HUMIDITY  
+ PHYSICAL WORK = HEAT ILLNESS

When the body is unable to cool itself through sweating, serious heat illnesses may occur. The most severe heat-induced illnesses are heat exhaustion and heat stroke. If left untreated, **heat exhaustion** could progress to **heat stroke** and possible death.



## Heat Exhaustion

### *What are the symptoms?*

HEADACHES; DIZZINESS OR LIGHTHEADEDNESS; WEAKNESS; MOOD CHANGES SUCH AS IRRITABILITY, CONFUSION, OR THE INABILITY TO THINK STRAIGHT; UPSET STOMACH; VOMITING; DECREASED OR DARK-COLORED URINE; FAINTING OR PASSING OUT; AND PALE, CLAMMY SKIN

### *What should you do?*

- Act immediately. If not treated, heat exhaustion may advance to heat stroke or death.
- Move the victim to a cool, shaded area to rest. Don't leave the person alone. If symptoms include dizziness or lightheadedness, lay the victim on his or her back and raise the legs 6 to 8 inches. If symptoms include nausea or upset stomach, lay the victim on his or her side.
- Loosen and remove any heavy clothing.
- Have the person drink cool water (about a cup every 15 minutes) unless sick to the stomach.
- Cool the person's body by fanning and spraying with a cool mist of water or applying a wet cloth to the person's skin.
- Call 911 for emergency help if the person does not feel better in a few minutes.

## Heat Stroke—A Medical Emergency

### *What are the symptoms?*

DRY, PALE SKIN WITH NO SWEATING; HOT, RED SKIN THAT LOOKS SUNBURNED; MOOD CHANGES SUCH AS IRRITABILITY, CONFUSION, OR THE INABILITY TO THINK STRAIGHT; SEIZURES OR FITS; AND UNCONSCIOUSNESS WITH NO RESPONSE

### *What should you do?*

- Call 911 for emergency help immediately.
- Move the victim to a cool, shaded area. Don't leave the person alone. Lay the victim on his or her back. Move any nearby objects away from the person if symptoms include seizures or fits. If symptoms include nausea or upset stomach, lay the victim on his or her side.
- Loosen and remove any heavy clothing.
- Have the person drink cool water (about a cup every 15 minutes) if alert enough to drink something, unless sick to the stomach.
- Cool the person's body by fanning and spraying with a cool mist of water or wiping the victim with a wet cloth or covering him or her with a wet sheet.
- Place ice packs under the armpits and groin area.

### *How can you protect yourself and your coworkers?*

- Learn the signs and symptoms of heat-induced illnesses and how to respond.
- Train your workforce about heat-induced illnesses.
- Perform the heaviest work during the coolest part of the day.
- Build up tolerance to the heat and the work activity slowly. This usually takes about 2 weeks.
- Use the buddy system, with people working in pairs.
- Drink plenty of cool water, about a cup every 15 to 20 minutes.
- Wear light, loose-fitting, breathable clothing, such as cotton.
- Take frequent, short breaks in cool, shaded areas to allow the body to cool down.
- Avoid eating large meals before working in hot environments.
- Avoid alcohol or beverages with caffeine. These make the body lose water and increase the risk for heat illnesses.

### *What factors put you at increased risk?*

- Taking certain medications. Check with your health-care provider or pharmacist to see if any medicines you are taking affect you when working in hot environments.
- Having a previous heat-induced illness.
- Wearing personal protective equipment such as a respirator or protective suit.

**ATTACHMENT 6**  
**MSDS Zinc Oxide**



## Search the NIOSH Pocket Guide

**SEARCH**

Enter search terms separated by spaces.

### Zinc oxide

#### Synonyms & Trade Names Zinc peroxide

CAS No. <b>1314-13-2</b>	RTECS No. <a href="#">ZH4810000</a> (/niosh-rtecs/ZH496510.html)	DOT ID & Guide <a href="#">1516 143</a> ( <a href="http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide143/">http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide143/</a> ) See: <a href="#">1314132</a> (/niosh/idlh/1314132.html)
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Formula ZnO	Conversion	IDLH 500 mg/m <sup>3</sup> See: <a href="#">1314132</a> (/niosh/idlh/1314132.html)
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<b>Exposure Limits</b> NIOSH REL : Dust: TWA 5 mg/m <sup>3</sup> C 15 mg/m <sup>3</sup> Fume: TWA 5 mg/m <sup>3</sup> ST 10 mg/m <sup>3</sup> OSHA PEL <sup>†</sup> ( <a href="#">nengapdxg.html</a> ) : TWA 5 mg/m <sup>3</sup> (fume) TWA 15 mg/m <sup>3</sup> (total dust) TWA 5 mg/m <sup>3</sup> (resp dust)	Measurement Methods <b>NIOSH</b> <a href="#">7303</a> (/niosh/docs/2003-154/pdfs/7303.pdf), <a href="#">7502</a> (/niosh/docs/2003-154/pdfs/7502.pdf); <b>OSHA</b> <a href="#">ID121</a> ( <a href="http://www.osha.gov/dts/sltc/methods/inorganic/id121/id121.html">http://www.osha.gov/dts/sltc/methods/inorganic/id121/id121.html</a> )  ( <a href="http://www.cdc.gov/Other/disclaimer.html">http://www.cdc.gov/Other/disclaimer.html</a> ), <a href="#">ID143</a> ( <a href="http://www.osha.gov/dts/sltc/methods/inorganic/id143/id143.html">http://www.osha.gov/dts/sltc/methods/inorganic/id143/id143.html</a> )  ( <a href="http://www.cdc.gov/Other/disclaimer.html">http://www.cdc.gov/Other/disclaimer.html</a> ) See: <a href="#">NMAM</a> (/niosh/docs/2003-154/) or <a href="#">OSHA Methods</a> ( <a href="http://www.osha.gov/dts/sltc/methods/index.html">http://www.osha.gov/dts/sltc/methods/index.html</a> )  ( <a href="http://www.cdc.gov/Other/disclaimer.html">http://www.cdc.gov/Other/disclaimer.html</a> )
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Physical Description White, odorless solid.	
MW: 81.4	BP: ?
Sp.Gr: 5.61	Fl.P: NA

Noncombustible Solid	
----------------------	--

Incompatibilities & Reactivities Chlorinated rubber (at 419°F), water [Note: Slowly decomposed by water.]	
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Exposure Routes inhalation	
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Symptoms Metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough; lassitude (weakness, exhaustion); metallic taste; headache; blurred vision; low back pain; vomiting; malaise	
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(vague feeling of discomfort); chest tightness; dyspnea (breathing difficulty), rales, decreased pulmonary function

**Target Organs** respiratory system

**Personal Protection/Sanitation** ([See protection codes \(protect.html\)](#))

**Skin:** No recommendation

**Eyes:** No recommendation

**Wash skin:** No recommendation

**Remove:** No recommendation

**Change:** No recommendation

**First Aid** ([See procedures \(firstaid.html\)](#))

**Breathing:** Respiratory support

**Respirator Recommendations**

**NIOSH/OSHA**

**Up to 50 mg/m<sup>3</sup>:**

(APF = 10) Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.

(APF = 10) Any supplied-air respirator

**Up to 125 mg/m<sup>3</sup>:**

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode

(APF = 25) Any powered, air-purifying respirator with a high-efficiency particulate filter.

**Up to 250 mg/m<sup>3</sup>:**

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.

(APF = 50) Any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode

(APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter

(APF = 50) Any self-contained breathing apparatus with a full facepiece

(APF = 50) Any supplied-air respirator with a full facepiece

**Up to 500 mg/m<sup>3</sup>:**

(APF = 1000) Any supplied-air respirator operated in a pressure-demand or other positive-pressure mode

**Emergency or planned entry into unknown concentrations or IDLH conditions:**

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

**Escape:**

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.

Any appropriate escape-type, self-contained breathing apparatus

**Important additional information about respirator selection (pgintrod.html#mustread)**

See also: [INTRODUCTION \(/niosh/npg/pgintrod.html\)](#) See ICSC CARD: [0208 \(/niosh/ipcsneng/nengo0208.html\)](#) See MEDICAL TESTS: [0246 \(/niosh/docs/2005-110/nmedo246.html\)](#)

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